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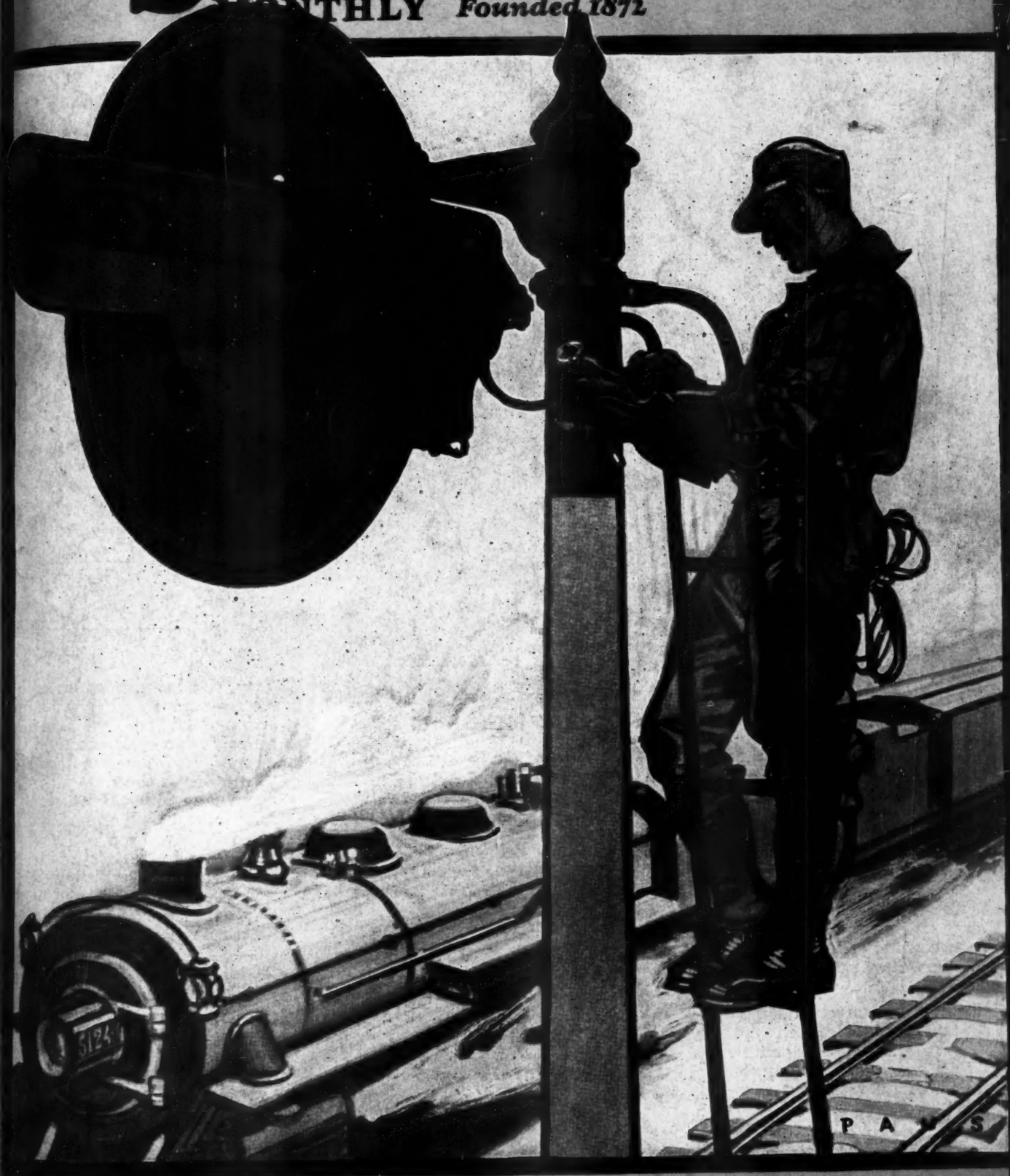

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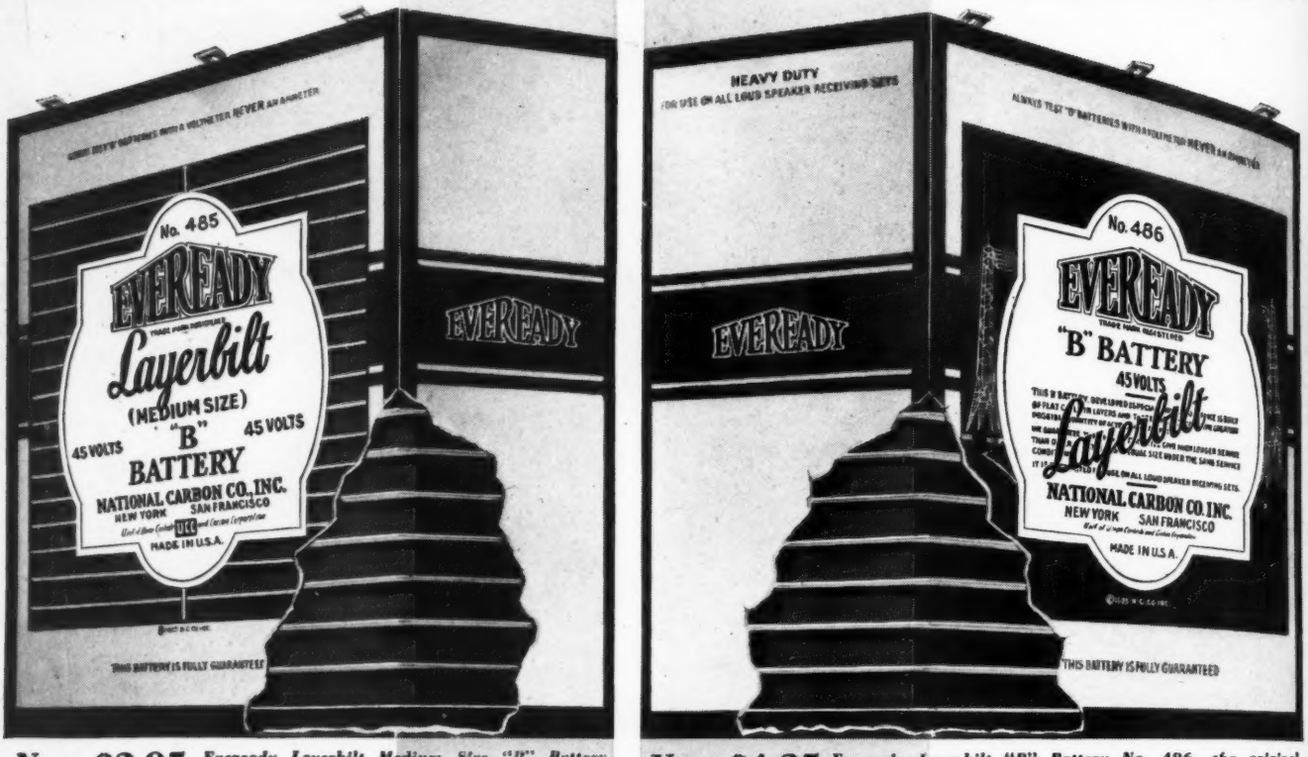

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For almost a quarter century, this reputation has been building. The business ethics and standards which have made it are *still* in daily force throughout the Cadillac-La Salle dealer organization—in used car as well as new car selling.

CADILLAC MOTOR CAR COMPANY

Division of General Motors Corporation

DETROIT, MICHIGAN OSHAWA, CANADA

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November, 1928, Vol. 113, No. 5. **Popular Science Monthly** is published monthly at 250 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1928, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

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"I Wish...."

said Joe Miller

"I missed my chance to make a wonderful investment when I passed up an opportunity to buy shares of Financial Investing Co. of New York, Ltd., when that investment trust was starting in January, 1925. I could then have purchased 100 shares for $1,500; today they would cost me over $2,800.

"And that's only half of it. In the last 3½ years I would have collected dividends and stock subscription rights amounting to $510. No wonder Financial Investing stock went up, even last June, when almost everything went down.

"I wish I had bought Financial Investing shares. That investment trust was established on a sound plan and has been conservatively managed by experts. Counting market gain I would have made well over 100% on my money in 3½ years. What a chance I missed!"

"I Will...."

said Jess Phelps

"I've got the same opportunity *now* that Joe Miller missed in 1925—a chance to buy shares of *Second* Financial Investing Corporation while it is on the threshold of its growth.

"Since Second Financial Investing Corporation and Financial Investing Co. of New York, Ltd., are both managed by United States Fiscal Corporation, and as both are alike in general plan and purpose, I believe that Second Financial *will do* what Financial Investing *has done*.

"I am going to invest in Second Financial *now* and profit as it grows."

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and
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Name _____

Address _____ 11 PS

Clipping the Wings of an Increased Salary

By WALLACE AMES, *Financial Editor*

"MARTHA!" called out Waldo Sims, as he burst in the front door of their bungalow one evening. "How soon can you jump into your best bib and tucker? We've got some important celebrating to do. I've reserved a table at the Monte Cristo Club right on the ring-side just for you and me. If we hurry we will get there in time for the dinner show."

"I'm sorry, but I am afraid you will have to cancel the reservation. This is Thursday, the maid's day off, and it is too late now to get anyone to come in and stay with Judy. What especially is there to celebrate tonight?"

"The luckiest break in the world! You're listening to the manager of the new West Coast sales branch. It is to be opened the first of the year with Yours Truly as the big boss. My salary is jumping from $125 to $150 and if I make a good showing the first six months it will be boosted to $175. And I'm to share in the profits, too. We will be living on $200 a week less than a year from now.

"As soon as we get out West we will join a country club. We'll sell the old bus right away and get one of those classy sport models and drive out to the Coast in style.

"Gee! I wish we could celebrate tonight. I tried to 'phone you so that you could make arrangements, but the operator said the 'phone was out of commission."

"It is probably a gentle hint," suggested Martha, "that the company would like to have last month's bill paid."

"They're getting fussy again, eh? That old company never lost any money through us. I'll call them up tomorrow and give them the devil."

"Waldo, I'm sick of all this," Martha burst out. "All the household bills drag on unpaid until it is embarrassing. You ought to see the way the butcher looked at me when I was in today. And what do our friends think when they can't get us on the 'phone? They know.

"And that's not the half of it. Year after year we go on paying profits to the landlord. Before you know it little Judy will be ready for college and there will be no money to send her with. Right now you've borrowed up to the hilt on all your insurance.

"When we were married you were making $60 a week and we lived comfortably on that. Now you are earning more than twice as much and we are not even getting by. Within two weeks of the time you got every raise the money was all spent. Now that you have another advance the first thing you do is to plan to spend it.

"You are a good natured, easy going spendthrift. You have business ability when you are in the office, or you would not have received this promotion. But when it comes to the business of managing your income you are a failure—just a failure." And Martha burst into tears.

"Why, honey, I never heard you talk like that before," said Waldo. "You don't really mean that the new Western sales manager is a failure. You're just excited over our good fortune and it has made you hysterical. Tomorrow you get your sister to go on a shopping tour and begin to outfit yourself for your new station in life. I want you to have a lot of new duds when we go West."

The next evening happy-go-lucky Waldo arrived home in his usual high spirits. "Did you go (*Continued on page 5*)

How Norman and Hattie Accumulated $32,000

This schedule of earnings, expenses and accumulations vividly shows how anyone on a normal salary can get ahead without hardship by conserving salary increases. On these figures this month's story is based.

Age	Weekly Salary	Living Expenses	Weekly Savings	Year's Investment Income	Total Worth at End of Each Year
24	$ 30	$25	$ 5	$ 5.20	$ 265.20
25	50	35	15	26.20	1,071.40
26	60	35	25	90.26	2,440.25
27	70	40	30	177.61	4,177.86
28	80	40	40	292.27	4,000.00 (3)
29	90	70 (1)	20	260.80	5,300.80
30	100	70	30	349.20	7,210.04
31	100	80	20 (2)	453.40	8,703.44
32	110	85	25	548.20	10,551.64
33	110	85	25	659.09	12,510.73
34	125	85	40	792.24	15,382.97
35	125	85	40	964.57	18,427.54
36	150	90	60	1,168.05	22,715.59
37	150	90	60	1,425.33	27,260.92
38	150	90	60	1,698.05	32,078.97

(1) Increased expenses due to marriage. (2) Decreased savings due to birth of child.
(3) Decreased worth due to expenses setting up housekeeping.

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Clipping the Wings of an Increased Salary

(Continued from page 4)

down town and get yourself some nice tricky new dresses today?" was his first question.

"No, Waldo. Hattie and I went down town, but I didn't do any shopping. Something made me change my mind."

"What was it, dear?" inquired Waldo. "You know we are partners and I want you to be the first one to profit by my good fortune in business."

"I met Hattie just before lunch. She wanted to go to the bank first. Norman had asked her to put two thousand dollar bonds in their safe deposit box and there were some coupons to clip and cash.

"I wish you could have seen their deposit box. Thirty-two bonds in it!"

"You don't say!" ejaculated Waldo. "Did some rich uncle die, unbeknown to us and leave them all that wealth?"

"Wrong again, Waldo. They bought those bonds with their own money. Some were bought with savings; income from their investments paid for the rest. Hattie told me all about them at lunch and what she told me spoiled my taste for spending money shopping.

"It seems that even before Hattie married Norman he had formed the habit of keeping his expenses below his income and saving the rest. Every time he got a raise in salary he saved most of it instead of blowing it in. So he had $6,500 when they were married. They spent $2,500 for furniture and a honeymoon trip and started life together with $4,000 ahead.

"Right from the beginning they kept their expenses under control. Of course they spend more now than they did ten years ago, but they have not allowed their increased living expenses to eat up every salary raise. When Norman was making $90 a week they lived on $70; when his salary was $125 they spent $85; now he is making $150 and they live on $90.

"This year their income from savings and investments alone amounts to nearly $1,700. On a salary just a little larger than yours they are now salting away nearly $5,000 a year, while we are continually getting deeper into the rut.

"That's what spoiled my taste for shopping this afternoon."

"Never mind, Martha. Everything is going to be all right. We'll be sitting on top of a pile of bonds some day. Just you wait and see."

"But don't you see, Waldo," earnestly entreated Martha, "you are going on and on, leaving the future to take care of itself. You say, 'Just wait and see.' I've been waiting ten years now.

"I was a little harsh with you last night. Really I was just as elated over your promotion as you, but my emotions got the best of me for once. Today I feel better because I have a plan by which we can profit by your increased income.

"If Hattie and Norman can live as comfortably as they do on $90 a week we can do it. When we get out West my plan is to start all over again, with a clean slate. If things go well and your income advances as we both *(Continued on page 6)*

$2,500 Interest *from* $10 a Month

$10 invested each month at 6½% with the interest reinvested at the same rate will accumulate $4,880.10 in 20 years. In these years you will have invested in cash only $2,400 and your earned interest will be $2,480.10—*more than the sum actually invested in cash.* Even at forty, if you invest $50 to $100 a month, you will be well-to-do by your sixtieth birthday.

6½% Compounded Semi-Annually

By systematically reinvesting the interest from your first bond, it will help to pay for another. Soon you will have interest on two bonds helping you pay for a third; interest on three bonds helping pay for a fourth, and so on. Can you think of a faster, surer method for the average man or woman to gain financial independence?

Send in your name and address on form below for free book, "How to Build an Independent Income."

USE THIS COUPON

THE F. H. SMITH CO
Investment Securities—Founded 1873
Smith Bldg., Washington, D. C.
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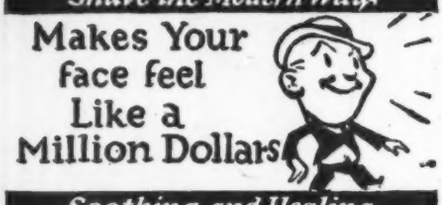
Shave the Modern Way



Soothing and Healing

Speed the shave 8 minutes

MOLLÉ *holds hairs erect*

No Pulling or Cutting

And so a million men have switched to MOLLÉ Shaving

"A million men can't be wrong" say the college chaps. So give your face a "break" and buy MOLLÉ. Get the giant half-buck tube from your druggist—or send a dime for the seven-day tube that has shown a million men the way to quicker, smoother shaving. Now we're working on the second million—come on along!

A whale of a tube for 50c—your druggist has it

The MOLLÉ Company, Cleveland, Ohio

THE MOLLÉ COMPANY, Dept. 84. Cleveland, O. Enclosed find 10c (coin or stamps) for which please send a week of MOLLÉ Shaves, to:

Name .....

St. No .....

City ..... *State* .....

Clipping the Wings of an Increased Salary

(Continued from page 5)

hope it will, let's save all the increase. Let's not think of new ways to spend money until we have a snug safe deposit box full of bonds.

"Once in a while we will go on a little bat, or indulge in some luxury and we'll enjoy it all the more, because we will know that we can afford it. It will be easy to change our habits in a new country and I can hardly wait to start."

"You are a game little kid, Martha, and the best little manager in the world. I am with you 100%," said Waldo.

And that evening was one of the pleasantest they had ever spent together, as they planned out the details of their new financial start.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with $100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

Retire *in* 15 *years*

on your* Present *living Budget

by investing in safe First Mortgage Bonds

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning $1,000 or $100,000 a year.

The way is certain—each step plainly indicated and absolutely safe—independent of luck, business genius or speculation.

Every fact has been harvested out of the 47 years' experience of Cochran & McCluer in the first mortgage investment banking business.

The plan is so simple, anyone can understand it—so definite anyone can follow it—and so certain, no one can fail.

In addition to the Financial Independence Plan and the unique budget schedule, the book gives suggestions that enable you to enjoy more of the good things of life, both while building your independent fortune and after you have attained it.

We invite the most skeptical to read this plain, straightforward, interesting book.

Send coupon. We employ no salesmen, therefore none will call.

Mail this

P. S. M.-11-28

Cochran & McCluer Co.
46 N. Dearborn St., Chicago, Ill.
Please send me, without obligation, your book, "How To Retire In 15 Years."

Name.....

Street.....

City.....*State*.....

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46 North Dearborn Street,
CHICAGO

The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in houses and other buildings.

It completely covers inside electrical wiring and construction in accordance with the National Electric Code. *Pocket size—flexible binding*

448 pp. **Price, $2.50**

POPULAR SCIENCE MONTHLY
250 Fourth Ave. **New York City**

and

. . . *via* Western Electric

THE very program that goes on the air through the well-known Western Electric microphone and broadcasting equipment can come into your home through the Western Electric No. 560-A.W. loudspeaker!

Wake up your radio with this new voice.

Let it tell you of the wonderful things there are in the air — things you do not suspect and cannot enjoy until you have a loudspeaker that brings them to you, in every delicate tone from the highest, sheerest violin tremolo to the deepest, fullest 'cello note.

All-around quality is inherent in this Western Electric loudspeaker. It is part of a 50-year old tradition covering a whole family of related products in the field of communication, including the nation's millions of telephones and network of switchboards and cables.

Western Electric

LOUDSPEAKER

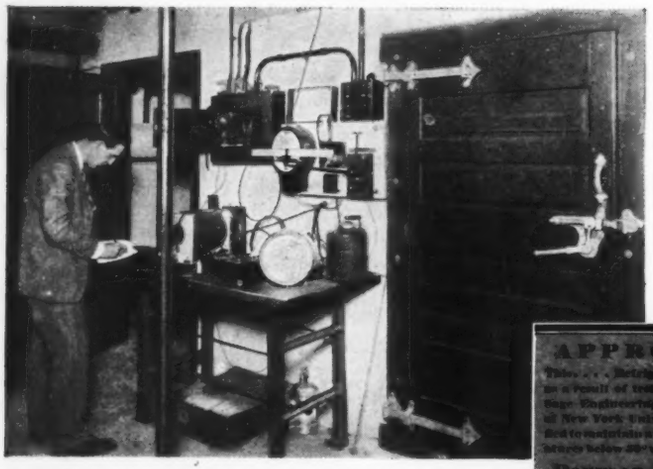
Distributed by

GraybaR
ELECTRIC COMPANY

Through authorized dealers everywhere

The Right Way to Save Ice

Some Surprising Facts about Refrigerator Care Are Brought Out by Laboratory Tests



Prof. Morrill outside the heat-insulated door of the constant temperature room in which refrigerators are tested.

By
Prof. R. D. Morrill
In charge of refrigeration at New York University and Popular Science Institute of Standards

"HURRY up and close the icebox door!" is an instruction that echoes through many an American home, and we sometimes wonder if this business of getting the refrigerator door closed quickly is worth all the commotion it causes.

Just what happens, when this injunction is not carried out as promptly as it ought to be, now has been definitely determined. Laboratory tests in which special recording thermometers settle the matter beyond question have been completed by the Popular Science Institute of Standards. The results show the true importance of opening refrigerator doors rarely and closing them promptly—not only for the saving of ice but, more important, for the maintenance of proper temperatures for keeping food safely free from bacteria.

With a good grade ice-cooled refrigerator that had two inches of corkboard insulation, a test was made to determine the rise in temperature inside when the food compartment doors were left open. The room in which the refrigerator was placed while these tests were being conducted was at a temperature of 77.6° F.

The refrigerator was fully iced at 8:35 A. M. and the food compartment doors were not opened until 1:45 P. M., when the refrigerator was down to a temperature of 51° F. The doors were then left open five minutes, and at 1:50 P. M. the average temperature of the box was up to 68.3° F. —a seventeen-degree jump in only a five-minute interval.

The food compartment doors then were closed from 1:50 to 2:35 P. M., the refrigerator temperatures being recorded at five-minute intervals during this period. By 2:35 P. M. it was found that the average temperature of the refrigerator had dropped to 52.4° F.

These results show that it requires a long time for the refrigerator to recover its lowest inside temperature if the food compartment doors are carelessly left open for several minutes. The time required for complete recovery was approximately ten times the interval during which the food compartment doors were left open.

This means that if a refrigerator is to be kept at a temperature that will safely preserve food, one of the most important requirements is that food be put in and taken out as quickly as possible, and that the doors be opened as few times in a day as possible.

But, while the quick closing of refrigerator doors is a good policy both from the standpoint of proper refrigeration and ice saving, the custom of wrapping the ice, followed in many households, is a very poor practice indeed.

Various so called ice blankets have been —and are still—advocated for wrapping ice to keep it from melting. Even newspapers and cloths have been put over the ice cake to preserve it. This practice prevents free circulation of air about the ice. Not enough ice is exposed to fully refrigerate the food compartments; also the entire surface of the ice cake is needed to absorb the food odors carried by the air.

Tests made on a good grade refrigerator in a room whose temperature was at 76° F. brought out the following results:

WHEN the ice was unwrapped, twenty-six pounds were melted in twenty-four hours. The temperatures in the milk compartment under the ice chamber, the bottom of the main food compartment, the center of main food compartment, and the top of the main food compartment were respectively 41°, 45°, 47°, and 50.5° F.

Keeping the same box in the same room temperature for twenty-four hours with the ice *wrapped* showed an ice meltage of twenty-three pounds. The refrigerator temperatures in the before-mentioned locations were, respectively, 43°, 46.5°, 49°, and 51.5° F.

These results demonstrate that three pounds of ice a day may be saved by wrapping the ice cake, which means a daily saving of less than two cents. Offsetting this money saving is the increased refrigerator temperature and its consequences. Food odors and bacteria are retained inside the refrigerator, instead of being caught on the surface film of water on the ice cake and discharged outside the refrigerator through the drain pipe and trap to the sewer. The ice surface must be exposed if full benefit is to be obtained, and if bacteria and food odors are to be absorbed properly.

FOR good refrigeration, it is essential that a well-built and well-insulated box be used, and that it receive proper care. This free List of Approved Refrigerators offers a solution to the buyer's problem of deciding which refrigerators are well constructed, a good value, and capable of maintaining proper temperatures economically with a minimum consumption of ice or power. The names of tested and approved refrigerators of both automatic and ice types can be obtained on request from the Popular Science Institute of Standards. Also, the engineers of the Institute have prepared a twenty-four-page booklet giving full information on the selection and care of refrigerators. There is a twenty-five-cent charge for the latter. Address the Popular Science Institute, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly
GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

This *grainless* wood board can be cut out, punched, die cut and shaped!

Has a smooth, attractive surface on the face side and requires no paint for protection. Also takes any finish beautifully. Possesses uniform strength, highly resistive to moisture, very dense and tough. New uses discovered almost every week. Send for large free sample, and find out what you can do with Masonite Presdwood.

FOR STORE FIXTURES

If you are a manufacturer, an inventor or a mechanic of any kind, you will certainly want to know all about Masonite Presdwood, the *grainless* wood board of a thousand uses.

Presdwood has now been on the market over two years, and in scores of industries it has helped to make good products better and cut down operating costs.

In fact, results prove that Presdwood is workable and adaptable almost beyond belief. It can be cut out. It can be die cut and punched. It will not crack or check. It will not split or splinter. It can be used on saw, planer, sander and shaper. It is highly resistive to moisture, it has uniform strength, it is very dense and tough. It has a smooth, attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

"A truly wonderful product," says practically everybody who has put it to the test. And note particularly that Presdwood contains no foreign substance of any kind, not even a chemical binder. It is simply wood torn apart and put together again—clean, fresh wood straight from the forest, and nothing else!

Astonishing range of uses

There actually seems to be no limit to the uses for Presdwood. We ourselves are astonished almost every week by some entirely new and unexpected demand for it.

Not only are thousands of feet of it going into the making of such things as table tops, breakfast nooks, store fixtures and signs, but it is being extensively used in the manufacture of toys, doll houses, fire screens, tension boards, bread boxes, clothes hampers, and dairy containers.

FOR PANELING

Bank vaults and telephone booths are lined with Presdwood. It is being widely used in building steam boats. It makes an ideal flooring for dance halls and park pavilions. It is becoming more and more popular for all kinds of paneling.

Cooling trays for hot castings, starch trays for candy factories, bedroom screens, invalid trays, incubators, dust arresters for journal boxes, bowling alleys, and shutters for Dutch Colonial Houses—all of these things are made of Presdwood.

Where especially fine, smooth work is required, there is nothing like Presdwood for concrete forms. Presdwood is used extensively in making movies. Not forgetting that the Chicago Art Institute has found this *grainless* all-wood board an excellent material for backing and protecting rare works of art!

Try Presdwood yourself

Presdwood has scores of other uses, and new uses are being discovered week after week. Remember, too, that Presdwood is not only workable almost beyond belief, but that it positively will not damage tools.

Adaptable for any woodworking machinery, uniformly strong, and highly resistive to moisture, it can also be lacquered, painted, stained or varnished. And yet it requires no paint for protection.

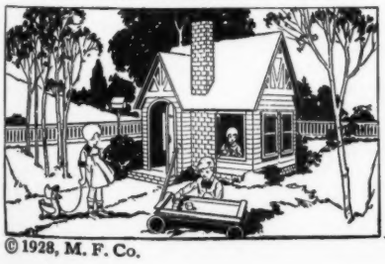
Write for a large, free sample of Masonite Presdwood, and find out what it will do for you. It may be the very material for which you have long been looking. It may enable you to make a worthwhile improvement in your product, and at the same time lower your operating costs. Try Presdwood for yourself!

MASONITE CORPORATION

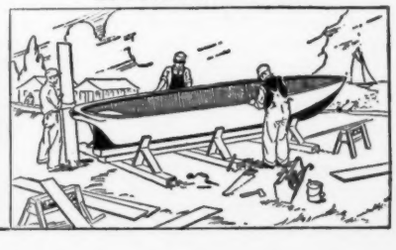
Sales Offices: Dept. 1211 111 W. Washington St.
Chicago, Illinois

Mills: Laurel, Mississippi

FOR PLAYHOUSES AND TOYS



IN BUILDING BOATS



Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

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Our Readers Say—

The Woman "Talks Back"

"THE article on 'Are Women as Smart as Men?' was exceedingly interesting. I am not a psychologist, nor could I be scientific if I had to; but I am a woman, therefore I enjoy talking back.

"As Mr. Lecky says, women are 'newly freed in body, newly independent in action and expression.' That is true now for the first time in history. Isn't it a bit early to compare the achievements of the two sexes? Women's interest in the science of government has been a case of 'hanging her clothes on a hickory limb.'

"I agree with Mr. Lecky that to 'get to the root of the question' we find it a matter of physical strength. But who shall say that barrier is eternal? When woman is far enough removed from the age-old barbaric customs that enslaved her body might there not be a different story to tell? I can remember when the mark of real ladyhood was a periodic fainting fit. Where are the ladies gone, anyway?

"Now to Mr. Lecky's point that women don't count large among the geniuses of the world because they don't want to be geniuses. That, too, is changing. Women still want to be sweethearts and wives and mothers, but the day of limited families has arrived, and women will soon find they can achieve their ideal of smaller families more scientifically reared, and still have years left for other kinds of creative production. Is it not possible that in the future some of the thirty-one even will be mothers?"—A. R. C., Rochester, Minn.

Can You Answer This?

"I WISH some of our moon-shooters and planet-pelters that call themselves scientists would make a thorough study of Sir Isaac Newton's Third Law of Motion, and then apply it to their high-powered sky-rockets. It seems to me that anyone with average intelligence could see that this method of going to other planets is absurd. I do not think anyone would be so ignorant as to deny or doubt this old law of motion. Then, if they believe in it, where in empty space will they get their resistance required to drive the rocket on?"—C. C., Greenville, Tex.

A Challenge to Inventors

"YOUR editorial 'Why Not Keep Cool?' in the September issue offered a real challenge to inventors and engineers. How long before we can have summer cooling plants for private homes? This last summer, artificial chilling breezes comforted thousands of the country's sweltering theater-goers, and made August heat endurable for brokers in the New York Stock Exchange. From that it is only a step to imagine a day when the man who tends his household boiler in winter will be regulating his chilling coils in summer.

"It is perfectly possible—but, today, far too expensive. There are two main difficulties, as explained by ventilating engineers. When you chill air, dew forms. Before you can blow cool air through a house you must take out the dampness, and the only practical way to do it is to chill the air more than enough, and then warm it a little. Running the expensive apparatus overtime costs money. So does the elaborate system of ducts and fans required to circulate the cool air. Hence, private homes, hotels, and apartment houses still await large-scale refrigeration.

"Perhaps the future will bring some simplified means of home cooling. There is a grain of hope in one engineer's statement that, in theory at least, it should be possible to hook up an electric refrigerator to a summer house-cooling system."—Dr. A. M., Baltimore, Md.

Only 64.6 Percent American!

"I WAS absolutely thunderstruck at your selection of the thirty-one greatest masculine brains of modern times. I noticed that your list contained 64.6 percent of American citizens which, in my opinion, is a greatly exaggerated percentage of the world's genius."—A. R., Glasgow, Scotland.

Fine Sport, But Take Care!

"HAVE been greatly interested in the glider article, 'Flying Planes without Motors,' in POPULAR SCIENCE MONTHLY for August, and I am hoping you can put me in touch with the American Glider Association, for we would like to start a club in the Hawaiian Islands. This is a fascinating sport, and we believe we have ideal country for it."—G. T. A., Honolulu, Hawaii, U. S. A.

"I am much interested in your article on gliders. Several young men in this vicinity are impressed by the wonderful feats of the German gliders, and we have decided to make a glider. I have interested two mechanics from Byrd Field, and they are willing to help us. We have decided to build a plane like those which more advanced students use, since we can get two or three pilots for instructors. The foreman of a lumber company has consented to get the lumber for us at a low price. We have an excellent location for flying and enough people interested to start a club."—F. V., Richmond, Va.

Pleasure from Tin Cans

"WOULD it be possible for you to induce Mr. Thatcher to give a further list of tin can toys than the ones he used illustrating an article in Popular Science a few months ago? Having made a steam roller for a small lad, I found this work to be fascinating, and I should like very much to do some more of it.

"As a retired Army officer, I find that time hangs heavily at times, and I use a small shop as a recreation as well as for practical purposes.

"I have in mind a plan to aid the county and state nurses in their work, as I have done formerly, in providing small appliances which it is difficult for them to obtain for the poorer patients, especially the children. A simple toy, they tell me, goes a long way to ease a fretful little one, and simple mechanical toys are especially useful in their work. I regret that our charities do not always consider that something pleasing to the eye may be of more value than something pleasing to the stomach."—J. B. D., Bel Air, Md.

All Joking Aside

"AMONG those who enjoyed the privilege of your 'Let Them Say!' was Alfranio do Amaral, director, snake serum farm, Butantan, Brazil, who was quoted as follows: 'Alcoholic liquors are harmful to persons bitten by venomous snakes.'

"Another argument for prohibition, I suppose. If so, shouldn't we pass a law making it a felony to be nipped by a rattler or struck by a copperhead? This is serious, I mean."—Dry as Dust, Tampa, Fla.

What Price Knowledge?

"YOUR readers' discussions of 'It' and personality plus have intrigued me to such an extent I feel it necessary to protest the notion that a cultured or versatile mind must necessarily be an interesting one.

"Perhaps you recall the story of Schopenhauer and his silent wager to drop a gold coin in the poor box whenever the officers at his table spoke of something other than women and horses. Schopenhauer was cultured, but his company was not much sought, nor were his thoughts conductive to good digestion.

"So, if you want to lead in conversation, leave science home and talk autos, women, and politics."—E. W. B., Allentown, Pa.

A Loyal Friend

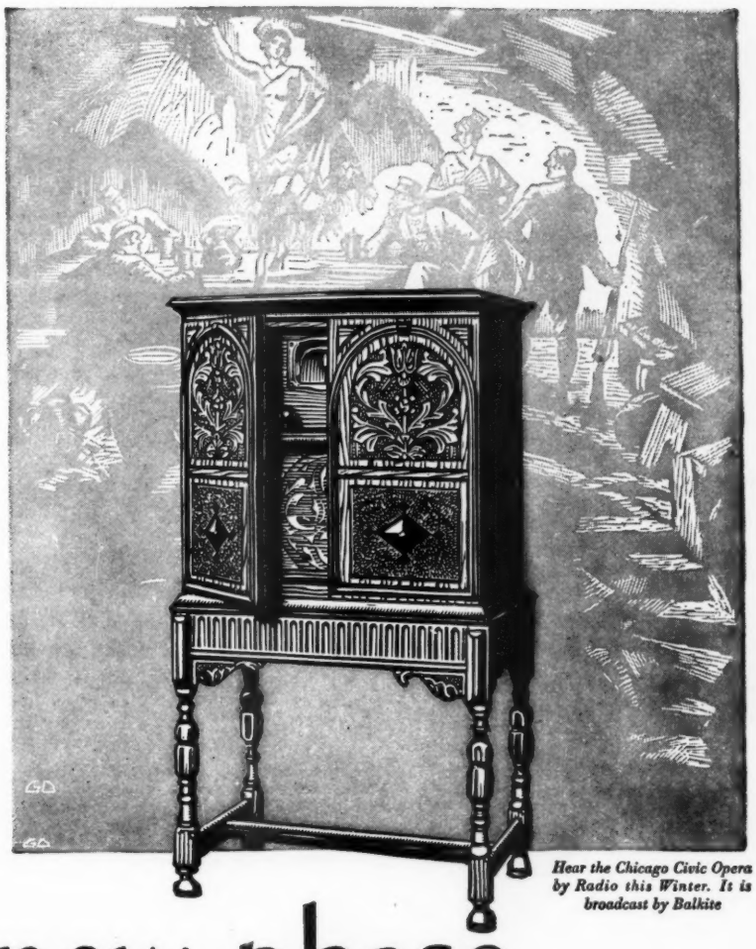
"I AM now seventy-eight years old and have taken your magazine since 1882. With the exception of some numbers which I loaned I have all the copies since then now on file. Wishing you success."—D. W. B., Norwalk, Conn.

Keep Cool, Gentlemen

"THE letter of W. J. M., of Sarasota, Fla., taking G. H. T. from Philadelphia to task for saying that 'only incidentally does a refrigerator act as a bacteria killer or inhibitor,' got under my skin. I quote from Farmers Bulletin 375: 'It must be remembered that refrigerator ice is often dirty and that it may bring in putrefactive and other bacilli, for most bacteria are resistant to low temperatures and are not destroyed by freezing.'

"While as a class bacteria grow best at a temperature of 80 to 95 degrees F., experiments have shown that few bacteria are injured by keeping them at temperatures considerably below freezing for months at a time. The average temperature of a refrigerator in the home is about 40 degrees, and this keeps the bacteria in a dormant state, but they will immediately begin to grow and multiply when brought to the temperature mentioned above. Would suggest that W. J. M. study up on his bacteriology."—G. S. E., Palmyra, N. J.

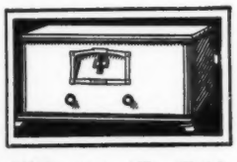
CABINETS BY
Berkey & Gay



Hear the Chicago Civic Opera by Radio this Winter. It is broadcast by Balkite

Radio enters a new phase

with the Balkite AC receiver



Balkite A-5—*The Table Model. Walnut cabinet, by Berkey & Gay.*

Balkite A-3—*The same, in a simple, but sightly, all-metal case.*

Balkite A-7—*Housed in a beautifully hand-carved walnut cabinet by Berkey & Gay. Completely equipped, including dynamic speaker.*

$175.00 *to* $450.00

Prices slightly higher West of Rockies

For some time the problem of faultless reception has been solved—in the laboratory. To make this quality of reception available in a simple, practical, permanent set—that is the radio problem for 1928; solved by the Balkite AC set.

Radio fans who have heard the marvelous reception now achieved in the laboratory, and who are familiar with the complicated mechanism required to produce it, are amazed at the Balkite chassis. For here is that same faultless reception, but accomplished by means that engineering refinement has reduced to utter simplicity, in a set that has the finality of a fine car.

Here, too, is AC without hum; a complete unit ready to operate from your light socket. It has push-pull audio, complete shielding, dynamic speaker power, a jack for reproducing records electrically. The circuit allows wide variation in voltage with safety to tubes.

The cabinets are by Berkey & Gay; an exterior elegance to match interior refinement. The dealer will gladly demonstrate . . . Fansteel Products Company, Inc., North Chicago, Illinois.

FANSTEEL
Balkite Radio

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

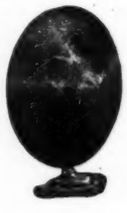
The first comprehensive use of the alphabet in signaling is attributed to Julius Africanus, a Roman general. He communicated between his troops by means of torches held aloft to represent different letters of the alphabet.

Get it *Better* with a Grebe

It is to a comprehensive understanding of the exacting demands of those who insist upon something "just a little better" in every phase of life that the Grebe Synchrophase A-C Six owes its perfection.

It was designed for those who want something more than the mere convenience of alternating current, light-socket operation; for those who want, in addition to relief from battery worries, the intrinsic quality that has made the Grebe such an outstanding leader in every phase of radio development.

If you aren't satisfied with something just good enough, you'll appreciate the tone quality, range and selectivity of this fine receiver; its freedom from A-C hum; illuminated single dial and other new improvements which truly enable you to "get it *better* with a Grebe."



A demonstration of the Grebe Synchrophase A-C Six will convince you of its superiority. Hear it today or send for Booklet P, which fully explains this new set.

Other Grebe sets and equipment: Grebe Synchrophase Seven A-C, Grebe Synchrophase Five, Grebe Natural Speaker (Illustrated), Grebe No. 1750 Speaker.

GREBE SYNCHROPHASE
TRADE MARK REG. U.S. PAT. OFF.

A-C Six
RADIO

A. H. Grebe & Company, Inc., 109 West 57th Street, New York City

Factory: Richmond Hill, N. Y. *Western Branch*: 443 So. San Pedro Street, Los Angeles, California

Makers of quality radio since 1909

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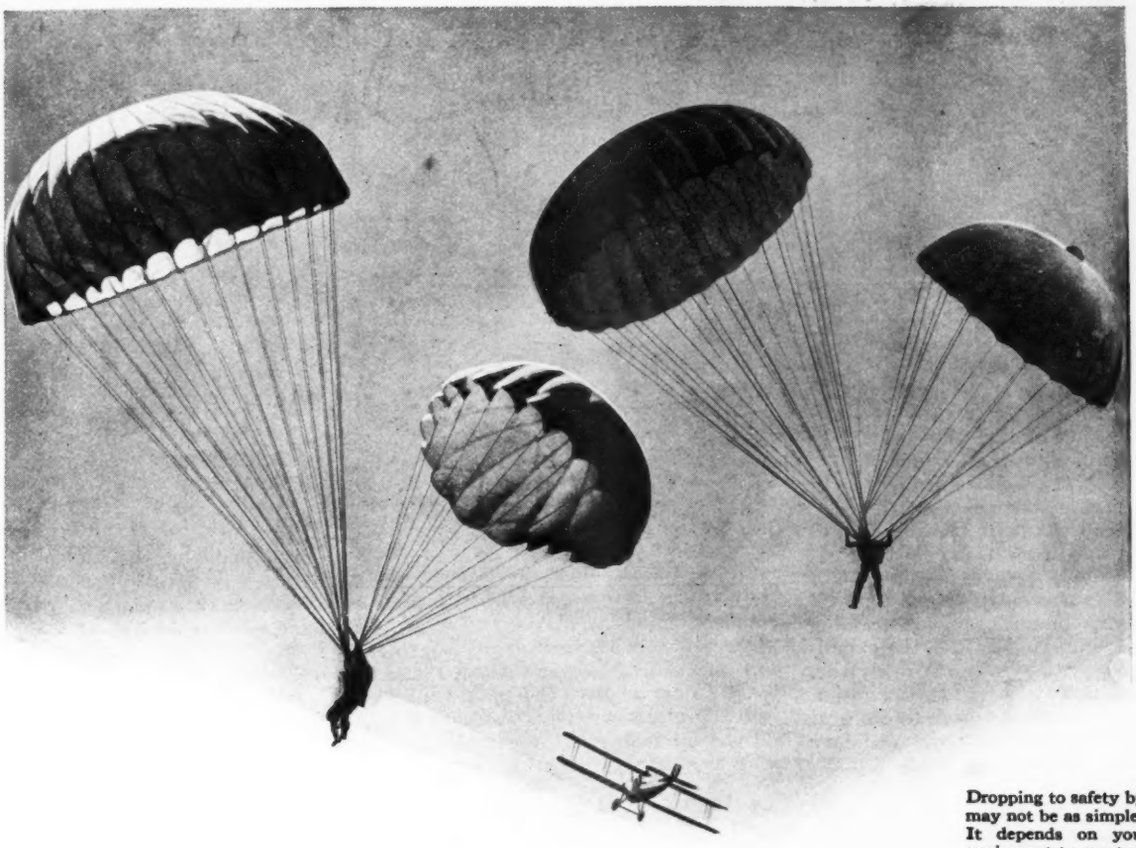
Popular Science MONTHLY

NOVEMBER, 1928 SUMNER BLOSSOM *Editor* VOL. 113, NO. 5



Dropping to safety by parachute may not be as simple as it looks. It depends on your physical equipment to meet emergencies.

Are You Physically Fit to Fly?

U. S. Medical Authority Explains the New Scientific Yardsticks of Your Capacity to Pilot a Plane Safely

By L. H. BAUER, M. D.

IN THE wake of the epochal flights of the last eighteen months a great wave of enthusiasm for aviation has swept the country. Every boy sees himself a potential Lindbergh. Thousands of Americans have made airplane flights as passengers; hundreds of young men—and men not so young—have enrolled in training schools for pilots. People who should know what they're talking about predict that soon airplanes will become as plentiful as "flivvers." This I doubt, although I do believe they will eventually supply a more or less common means of transportation.

In all this talk about aviation and its future, it has struck me as highly remarkable how few persons give any thought to a phase of the subject, which, in my opinion, is of prime importance—namely, flying and physical condition. After several years' study of this question, during which time I have been in daily contact with flyers, I would say that if you wish to learn to fly, the very first thing you must do is to take a physical examination. Moreover, this examination cannot be an ordinary one such as you might take for a life insurance policy. It must involve so many different factors and so many special tests that its comple-

FOR more than six years Doctor Bauer was Commandant of the Army School of Aviation Medicine. Since resigning from the Army more than a year and a half ago, he has been Medical Director of Aeronautics for the U. S. Department of Commerce. In this capacity he has passed on the physical examinations of all civilian flyers applying for Government licenses—more than 10,000 in all. Simply and understandably he answers here the questions you have been asking about your physical fitness to fly an airplane.

Left: Testing the hearing of a candidate for Army training. While normal hearing is not essential, a pilot must be able to hear the voice of his mechanic and listen to radio signals.

Below: Determining a candidate's reaction to high altitudes by subjecting him to varying artificial atmospheres. This test is especially important for military flying service.

tion leaves no doubt of your physical soundness or of your possession of the highly special physical attributes necessary to successful piloting.

Such mention of the physical examination of flyers as I have heard usually takes the form of criticism. Yet as strong presumptive evidence that a physical examination, far from being just another obstacle placed in the prospective pilot's path, actually is a necessary preliminary to a training course in flying, I might cite the experience of the British in the World War. During the first year, British aviation recruits underwent no special physical examinations, other than the ordinary examinations given to all soldiers.

MANY men who had "washed out" as infantry officers were sent to learn to fly. As a result, of every 100 aviators killed, two were killed by the Germans and sixty by their own physical defects. After the adoption of a more careful standard for the selection of flyers and the institution of a system of medical supervision, this sixty was reduced within a year to twenty, and later to twelve. Accidents due to physical causes are uncommon now among our Army and Navy flyers as a result of careful selection and supervision.

I knew a famous flyer who was ill from grippe. He "doped up" on aspirin and continued to stay up nights on wild parties. Though begged by a flight surgeon not to fly on a certain day because of his physical condition, he disregarded the advice and went on what proved to be his last flight.

Another flyer was advised not to fly because he was unable to judge distance. He miscalculated his distance from a telephone pole a few days later and washed out his ship. Still another, whose name figured prominently in the headlines not long ago, was advised not to fly because of defective vision and inability to judge distance. He flew to his death about two weeks later because he was unable to distinguish his landing place clearly and misjudged his distance from it.

As a result of bitter experience corroborated by much research, practically all countries now have almost the same rigid physical standards for flyers. They recognize that Nature never intended man to fly. Consequently, the man who goes into the air, where he is subject to conditions different from those on the ground, must possess unusual physical resources. Do not misunderstand me. A flyer need not be a superman. There are millions of young men in this country physically qualified for flying. It is interesting to note that transoceanic flyers applying for commercial licenses, including Lindbergh, Chamberlin, Brock, Goebel, Acosta, Haldeman, and Ruth Elder, met these physical standards without difficulty.

Why should flying call for a higher physical standard, and what factors are of special importance?

First, I would say, come the eyes. More men are rejected because of defective eyesight than for any other physical reason.

GOOD vision is vital to safe flying. The flyer must be able to distinguish objects clearly, such as the character of the terrain, or other planes in his vicinity. More than one flyer with defective vision has been killed because he failed to see a plane about to land as he was taking off, or vice versa, or because he missed seeing one in the air and collided with it. He must be able to read his instrument board and his map. All this requires eyes that can see at a distance, that can change focus quickly from far to near, and that permit peripheral vision as well as central.

These terms probably require explanation. The normal individual, when looking straight ahead, sees clearly what is directly in front of him. This is central vision. At the same time he is aware of objects at either side, although they are not seen so clearly. This is peripheral vision. If a person lacks that peripheral vision—in other words, if his fields of vision are narrow—he is unable to see anything unless he is looking directly at it, much the same as a horse wearing blinders. It also happens that when a man has these constricted fields of vision he is likely, too, to be suffering from what is known as "night blindness," in which case he would better be home before dark.

But why cannot a person with defective vision wear glasses while flying, as he would if driving an automobile? Some flyers do, but it is a severe handicap. For one thing, glasses must be worn under goggles, which means that the flyer is looking through two panes of glass.

ALSO the lenses of glasses are small in comparison with the lenses of goggles. So long as the flyer is looking straight ahead he has adequate vision, but when he turns his eyes to the side his vision becomes blurred and distorted because his glasses do not cover his whole visual field. Now what about having proper correcting lenses ground in the goggles? This has been tried, but certain corrections cannot be ground into a lens the shape of a goggle lens. In such cases, a corrective insert is slipped into the frame with the goggle lens. This insert is open to objections because it, again, corrects only about two thirds of the field of vision, giving blurred vision for the other third; it easily becomes dirty and is hard to clean. Furthermore, if a flyer wearing correcting lenses in his goggles should get a smear of oil on his lenses when landing, he would be in a dangerous predicament. Either he would have to tear off his goggles and deprive himself of his correction or leave the smeared goggles on and perform with blurred vision one of the most delicate operations of flying.

SO IF you want to learn to fly with a view to becoming a military or commercial transport pilot, you must have normal, or 20/20, vision, normal visual fields, and a moderate amount of accommodation (the power to change the focus of the eyes from far to near). If you wish to become an industrial pilot and carry mail or freight, but no passengers, your vision may be slightly less, or 20/30; and if you wish to fly for your own pleasure your vision may be still less, or 20/40. By these figures is meant the ability to see at twenty feet what should be seen at twenty feet, thirty feet, or forty feet as the case may be.

The ability to judge distance, while dependent in part on experience, is dependent chiefly on the eyes. Every time you take off or land it is necessary to judge exactly your distance from the ground, and from obstructions such as trees, planes, buildings, telephone poles, and wires. Your ability in this particular is tested by an ingenious apparatus invented by Dr. H. J. Howard and modified later by Dr. P. Dolman, in which, while looking through a window in the front end of a box placed twenty feet away, you endeavor by means of a cord

and pulley to place two 3.8-inch rods side by side.

There are six little muscles that control the movements of each eye. These muscles are so coördinated and balanced in the normal individual that they cause the two eyes to act in unison and we see only one object. When the muscles are not properly balanced, either we see double or else we make a constant effort to maintain single vision. This effort is fatiguing; it causes headaches, which lead to inattention and carelessness. The balance of these muscles is closely associated with defects of vision and with the judging of distance. You can appreciate that disturbances of this balance may be serious in the flyer. The "ocular muscle balance," as it is called, is tested by means of prisms, which indicate the strength and weakness of the various muscles. Certain tests are required of all pilots, but the most complete examination is made of military and commercial transport pilots.

Measuring a prospective flyer's ability to see clearly and judge distances accurately. This prism instrument tests the balance of the muscles that control the eye movements.

COLOR vision comes next. Its importance may be appreciated when you recall that airplanes carry navigating lights, airdromes have colored lights, signaling is done with colored flares and panels, maps are often printed in colors, and perhaps most important of all, that different shades of brown and green seen on the ground indicate to the flyer the character of the terrain. This latter is particularly important if he has to pick out a landing field.

Finally, the eyes are examined to determine whether any disease of the eyeball or lids would interfere with clear vision or cause the eyes to water easily, thus producing dangerously blurred vision.

The next part of the examination, and perhaps the least important, pertains to the ear, nose, and throat. The candidate should be free from any disease that would, under fatigue or exposure, "light up" in an acute infection; and he should have no marked obstruction to breathing. Normal hearing is not essential but he should be able to hear his mechanic when he says "contact" or "switch off," and for certain classes of flying he should be able to hear radio signals.

Since the plane of equilibrium of a flyer is constantly changing, he must be able to orient himself regardless of position. Equilibrium is a function of several organs. Eyes play an important part, so do the ears, and also the sensations received from muscles, joints, and internal organs. The effects of gravity also play a part. During the World War, and for a time afterward, a person's equilibrium was tested (for flying) by a turning chair. This now has been replaced in the Army and for commercial flying by a much simpler test. The candidate is told to stand on one foot, flex the other leg at a right angle at the knee (keeping it away from the other leg), close the eyes, and maintain the position for fifteen seconds.

The candidate is then given a general physical examination. Particular attention is paid to the heart, circulation, lungs, and kidneys, as organic disease of any of these lowers resistance, becomes accentuated by fatigue, stress, and exposure, and may develop serious crises.

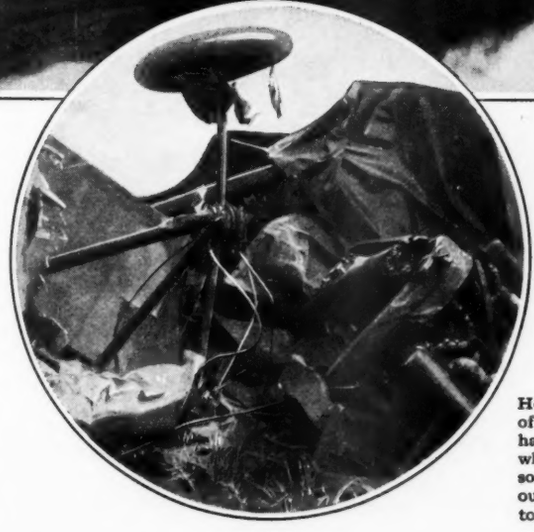
Structural defects are looked for, such as hernia (rupture), and limitation of motion of joints. The flyer should have all his extremities, free motion at the shoulder, elbow, and hip. Slight limitation of motion in the knee is not disqualifying and even fifty percent limitation may be permitted in the wrist and ankle.

Abnormalities of the thyroid gland, also, are cause for rejection, because of the serious constitutional effects of certain types of thyroid disease.

As important as the eyes is the nervous system. The person with an unstable nervous system does not last long as a flyer. Of course, organic nervous disease at once disqualifies. One would not think of sending into the air a person afflicted with a paralysis, a mental disease, or epilepsy. In addition effort is made to eliminate the neurotic persons. Experience has shown that they go to pieces quickly and rarely make good flyers.

Flying is attended by a physical and nervous strain. This may not show in a sound, stable individual who takes care of himself and who flies not more than four hours a day; but in the unstable type, in the man who frequently dissipates, or who is flying five and six hours day after day, it manifests itself in irritability, loss of interest in work, morbid fears while flying, and even a dislike of going into the air. The man loses weight, sleeps with difficulty at night, and when he does sleep, dreams of air accidents. There were countless such cases on record during the World War. Peacetime flying is less likely to produce this "stale" condition, but even here it will develop in certain individuals.

U. S. Army planes in formation flight above the clouds. Flying wing to wing calls for precise judgment of distance. A slight error may mean a collision.



Here is a tragic picture of what frequently happens when a man who is suffering from some physical or nervous defect attempts to operate an airplane.

The ideal age for flying is the period from twenty to thirty years. You may make a successful flyer if you learn after thirty-five, but the chances are slim, and these chances rapidly diminish as your age increases. Flyers who learned when young and have kept in good physical trim and have kept up their flying remain good flyers, but lacking the keenness of youth, they are not fitted for combat flying, for example. There are flyers over fifty who learned to fly late in life, but such men are not fitted for the wear and tear of commercial aviation. Middle age brings a development of conservatism, a slowing of reaction time and a loss of physical resiliency that do not go well with flying.

Commercial flying is not much concerned with high altitude, but military flying is. Combat flying is done at 18,000 to 20,000 feet. Not all men react equally well to high altitude, and no man should fly above

(*Continued on page 169*)

Dreamer, prophet, and practical inventor, Nikola Tesla holds a high place among the world's creative geniuses. At the age of seventy-one, he still labors in the laboratory to turn his visions into useful forms.

A Famous Prophet of Science Looks Into the Future

By ALDEN P. ARMAGNAC

PEERING into the future is, for most of us, mighty chancy business. For Nikola Tesla, world-famous electrical wizard and inventor extraordinary, it is second nature.

He is an enigma, this man Tesla. His astonishing discoveries and his prophetic visions have established him in the popular mind as a genius and a fantastic dreamer. Turned into practical form in his induction motor, high voltage transformer, and system of alternating current transmission, his fancies have brought him fame, fortune, and a place among the immortals.

At times they have subjected him to ridicule. In the dozen years since a catastrophe halted his last great project—to supply the world with power by wireless—he has spoken only rarely of his projects. But at last he has broken his silence for the readers of POPULAR SCIENCE MONTHLY.

Within three years, he told me, his "World-system" for transmission of wireless power through the earth should be in commercial operation. Other wonders, too, he described—a "flivver airplane," his latest invention; and a powerful new turbine motor which, he said, has but one twentieth the weight of an engine as now designed. It was a staggering word picture of the future that Tesla gave me.

BUT thirty-five years ago people decried as impossible Tesla's prophecy before scientific societies that ships in distress at sea would call for help by wireless apparatus. It was characterized as "inventive lunacy." Many of these unbelievers lived to see wireless summon rescuers to lost explorers stranded on an Arctic ice cake.

Thirty years ago people thought Tesla was indulging in a wild fancy when he built a model for a crewless vessel. Yet today the British Navy is experimenting with H. M. S. *Centurion*, a full-size warship without a crew, controlled entirely by wireless. Germany is doing the same with the former battleship *Zaehringen*. Airplanes and automobiles have been run by radio control.

Twenty years ago, when Tesla designed an automobile to be propelled on water, land, or through the air by explosive jets from rockets, men who otherwise respected his genius thought he had gone crazy. Today, in Germany, rocket cars have sped 156 miles an hour in trials; and the principle is to be applied to air machines.

So this man, past three score and ten, commands attention as a scientific forecaster; for, he says, his predictions are simply the logical conclusions from facts already known or ascertainable. A world enjoying the fruits of his basic researches in power transmission, propulsion, wireless, and other fields is compelled to give heed as he predicts greater wonders to come. Here are some that he sees:

Houses will be lighted and powered by wireless, as will be airplanes and other vehicles on land and sea. You will be able to go anywhere, desert or mountain-top, valley or farm, and set up a compact equipment, small enough to be carried in a suitcase, that will give you heat to cook with and light to read by. Flivver airplanes will buzz directly upward and dart across country at many miles a minute. Jet-driven airships will cross oceans, but Tesla draws the line at moon rockets.

To talk with Dr. Tesla is to become acquainted with an extraordinary life packed with adventure into uncharted realms of knowledge. Ever since his boyhood, in the village of Smiljan, Jugo-Slavia, his mind has been hunting in unexplored places. As a student at Gratz, Austria, he astounded professors by his prodigious mental feats. Once he won a wager with a fellow-student by reciting an entire volume from memory!

ONE day the students received from Paris a Gramme motor, an early type that sparked badly. Tesla suggested that a motor might be produced without the brushes that transmit electricity to the spinning rotor, thus eliminating the trouble. It couldn't be done,

Crackling artificial lightning of millions of volts produced by Tesla at Colorado Springs in 1899. The noise of it was heard thirteen miles away.

his professor of physics told him. His classmates jeered.

Less than five years later, Tesla invented just such a machine, the "induction motor" which brought him fame. Without brushes, it operates on the principle of the "rotating magnetic field"—a sort of magnetic cyclone, discovered by Tesla, that grips the armature and whirls it.

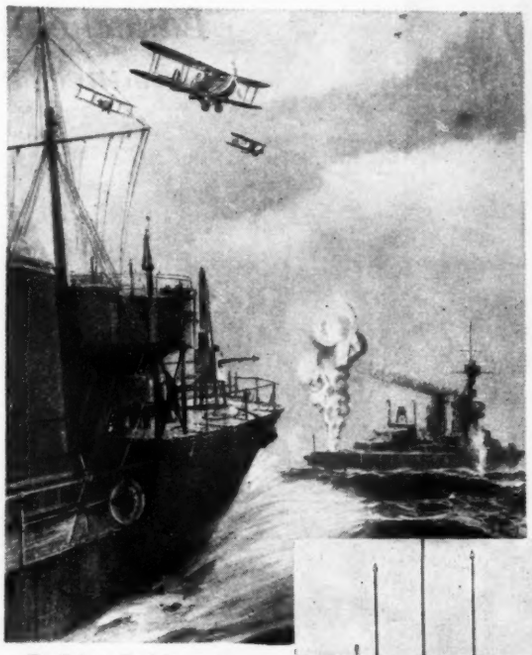
After this discovery, described by such a hard-headed engineer as H. W. Buck, president of the American Institute of Electrical Engineers, as "one of the greatest feats ever performed by human mind," Tesla came to America. He invented the "Tesla coil" or "Tesla oscillation transformer." Today every wireless transmitter and receiver embodies this great principle, which has also been put to innumerable other uses in science and industry.

With it, he turned ordinary electricity into crackling lightning of millions of volts. Noises of thunderous discharges smote the ears of visitors to his Colorado Springs, Colo., wireless plant erected early in 1899; they could even be heard in Cripple Creek, Colo., thirteen miles away!

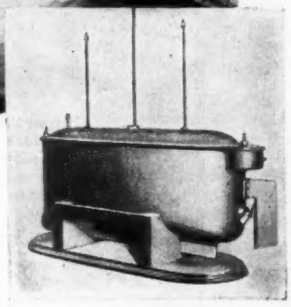
IT WAS there that Dr. Tesla carried out his scheme of sending power by wireless through the earth. No "wireless" such as we know today as radio, was this. He transmitted, not radio waves through the air, mostly wasted, but electric currents through the ground. By this method, he told me, he transmitted enough power around the earth to light several hundred incandescent lamps, and proved that power in industrial amounts could be transmitted to any distance with an efficiency as high as ninety-nine and a half percent.

As a result of these experiments, residents of Shoreham, L. I., New York, were mystified in 1902 by a massive tower of steel rising nearly 200 feet in an open field. "Tesla's tower," they called it; for rumor had it that from it Tesla would hurl thunderbolts into the earth.

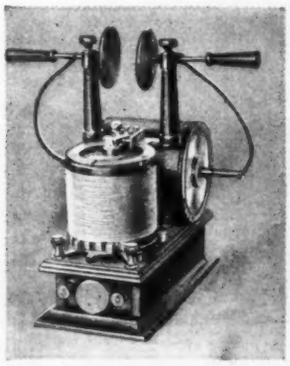
In reality the tower was Dr. Tesla's "Magnifying Transmitter," intended to feed electric power into the earth. At its top, a globular dome was to store momentarily, before hurling into the earth, tremendous currents produced by a "Tesla oscillation transformer" in the tower's center. Nearly completed was the odd structure, when a dynamite blast of unknown origin turned it into a twisted mass of ruins.



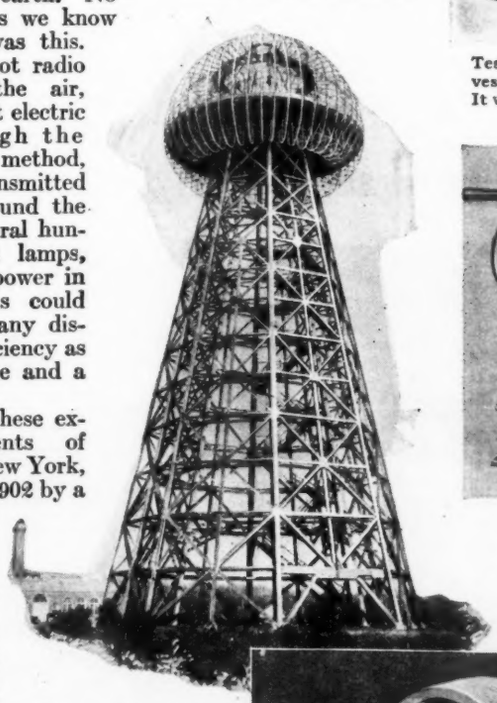
Realizing Tesla's dream—our artist's conception of the crewless warship in action, based on actual tests of the British warship *Centurion*. On the stern is the wireless control receiving apparatus.

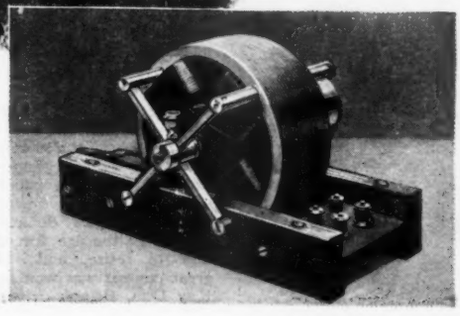


Tesla's model for a crewless vessel, built thirty years ago. It was called a "wild fancy."



The original Tesla coil or "oscillation transformer," whose principle is embodied today in every wireless transmitting and receiving set.





Above: The 200-foot "Tesla's tower" at Shoreham, Long Island, destroyed by dynamite blast in 1914. Its purpose, Tesla explains, was to feed tremendous electric currents into the earth for transmission. At the right is shown the induction motor, one of Tesla's greatest discoveries.

Today he is ready to build a new and larger plant. And he is confident that by 1931 it will be in commercial operation. This plant was also to broadcast speech, and pictures by a system of daylight television without moving devices outlined by him in 1893.

"Contrary to popular opinion, which has identified my 'Magnifying Transmitter' with thunder and lightning," Dr. Tesla said, "it operates in silence. There is no halo of escaping electric flames, or other visible evidence of activity—except that a person within a hundred feet of the tower will notice small sparks, prickling of the skin, and bristling of the hair."

A fantastic dream? Perhaps—but Tesla has dreamed such dreams before and seen them come true.

BESIDES his world power scheme, Dr. Tesla says he is devoting his time chiefly to his vertically rising flying machine. This aerial flivver is to weigh less than 200 pounds, and to occupy no more space than a seven-foot cube. It is to rise to a great height at a rate of from one to two miles a minute, and may attain a horizontal speed as high as 400 miles an hour, power being supplied by an exceedingly light oil-burning motor, a modification of a steam turbine Tesla invented. An all-metal framework and the absence of gasoline guard against fire hazard. Additional safety is to be attained by a parachute of new construction.

Unlike inventors who work with the tedious process of trial and error, Tesla visualizes his inventions, full-fledged, even to the smallest detail. One evening he was walking with a friend through the City Park of Budapest, quoting from a book of poems he had learned by heart. In the middle of a line he broke off, seized a small stick, and scratched a rough picture on the sand. It was his induction motor, revealed to him in its entirety! And the plan he drew was the same that, seven years later, he presented to the American Institute of Electrical Engineers.

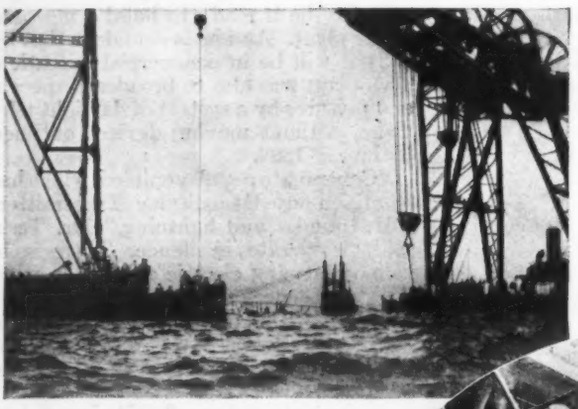
EQUALLY spectacular was his demonstration of a wireless lamp, at his Grand Street laboratory in New York City. At three o'clock one morning, when he and his workmen were ready to quit for the night, Tesla decided that a certain high-frequency generator he had been constructing was ready for the test of a new lamp that would light without wires. He sent his workmen outside while he made ready the apparatus. All that remained was to close a switch.

When the workmen returned, Tesla strode to the middle of the laboratory. In each hand he held a long glass tube, exhausted of air. "If my theory is correct," he told his assistants, "when the switch is thrown in, these tubes will become swords of fire. Darken the room and close the switch."

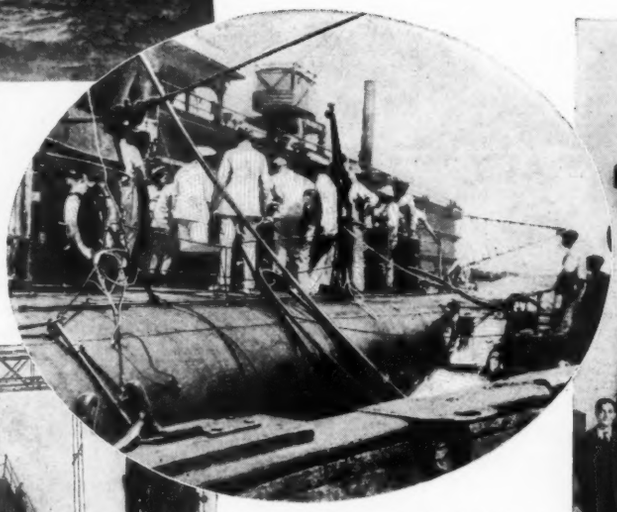
The lights went out, and there was a faint click. (*Continued on page 170*)

Camera News of

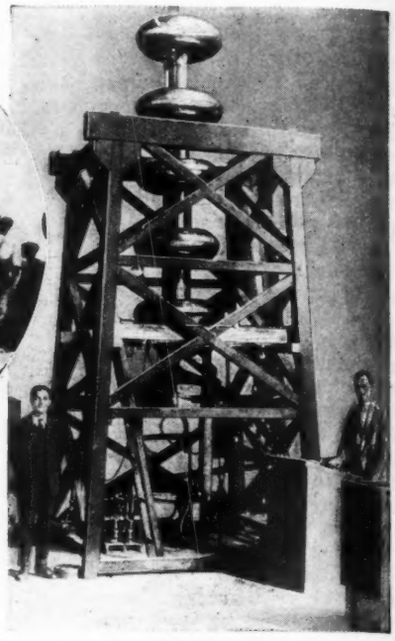
The Raising of Submarine Launched — World's Largest Advances in Undersea Rescue,



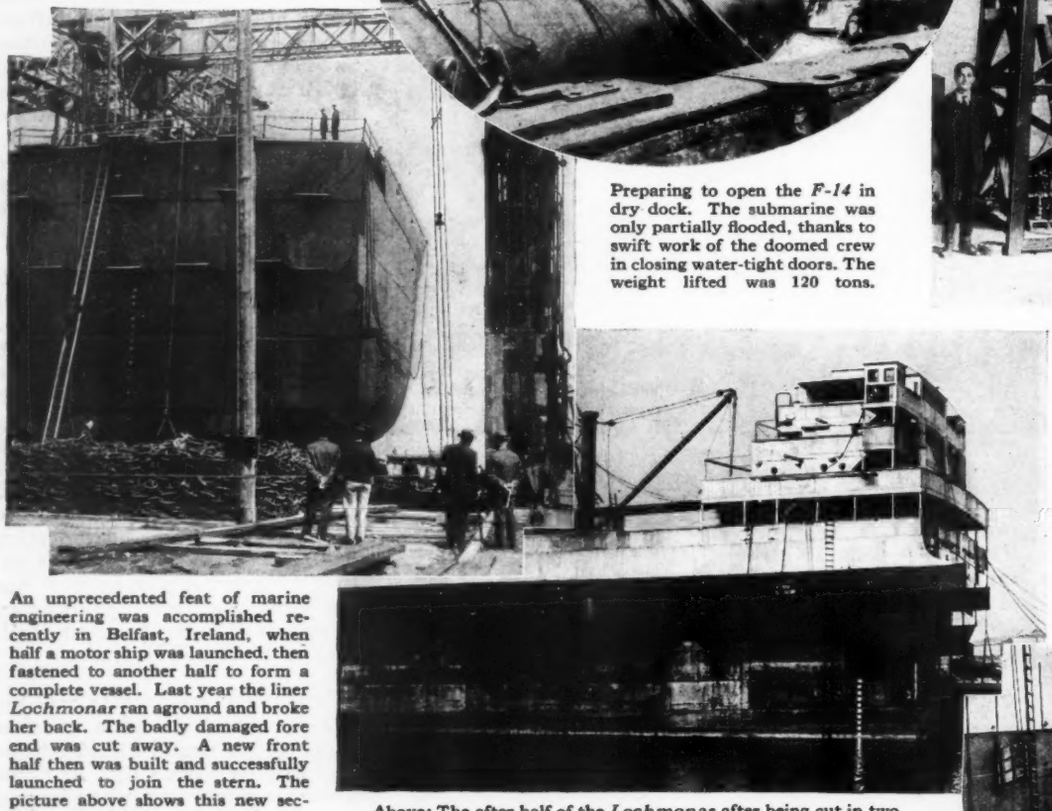
Though the entire crew of the Italian submarine *F-14* perished from suffocation when their ship was rammed and sunk by a destroyer in the Adriatic Sea a few weeks ago, the successful raising of the wreck in thirty-four hours was praised by experts as a remarkable feat of salvage. Huge floating derricks lifted the hull from the bottom. Above: the submarine being towed to drydock.



Preparing to open the *F-14* in dry dock. The submarine was only partially flooded, thanks to swift work of the doomed crew in closing water-tight doors. The weight lifted was 120 tons.

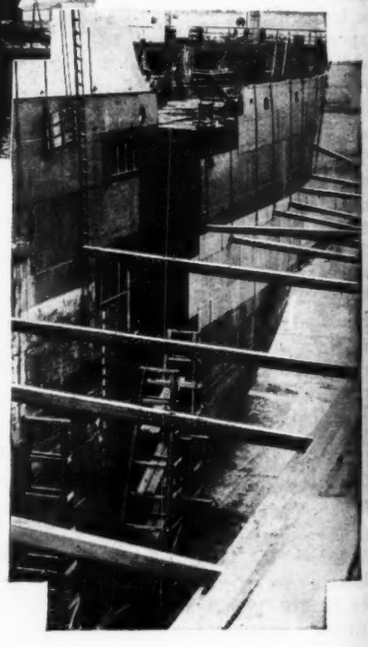


X-rays five times as powerful as those used in medicine are produced by this giant million-volt tube, largest in the world, assembled at the California Institute of Technology in Pasadena. Glass jars fastened one on top of another form a tube twenty feet high. For safety it is controlled by switches in a concrete tunnel, with mirrors for observation.



An unprecedented feat of marine engineering was accomplished recently in Belfast, Ireland, when half a motor ship was launched, then fastened to another half to form a complete vessel. Last year the liner *Lochmonar* ran aground and broke her back. The badly damaged fore end was cut away. A new front half then was built and successfully launched to join the stern. The picture above shows this new section completed and ready to be sent down the launching ways.

Above: The after half of the *Lochmonar* after being cut in two. Made water-tight, this half was floated from Liverpool to Belfast where it was joined to the new fore half. The view at the right shows how the two portions of the boat were brought together.



Left: A thrilling moment during the recent 410-mile motor road race for the International Tourist Trophy at Belfast, Ireland. The famous British speed king, Capt. Malcolm Campbell, is seen trying to extinguish a blaze which enveloped his car during the race. The damage caused by the fire forced him to retire, and the great contest was won by Kay Don, British driver

Unusual Events

F-14 — *How Half a Ship Was X-Ray Tube — The Latest Television, and Color Movies*

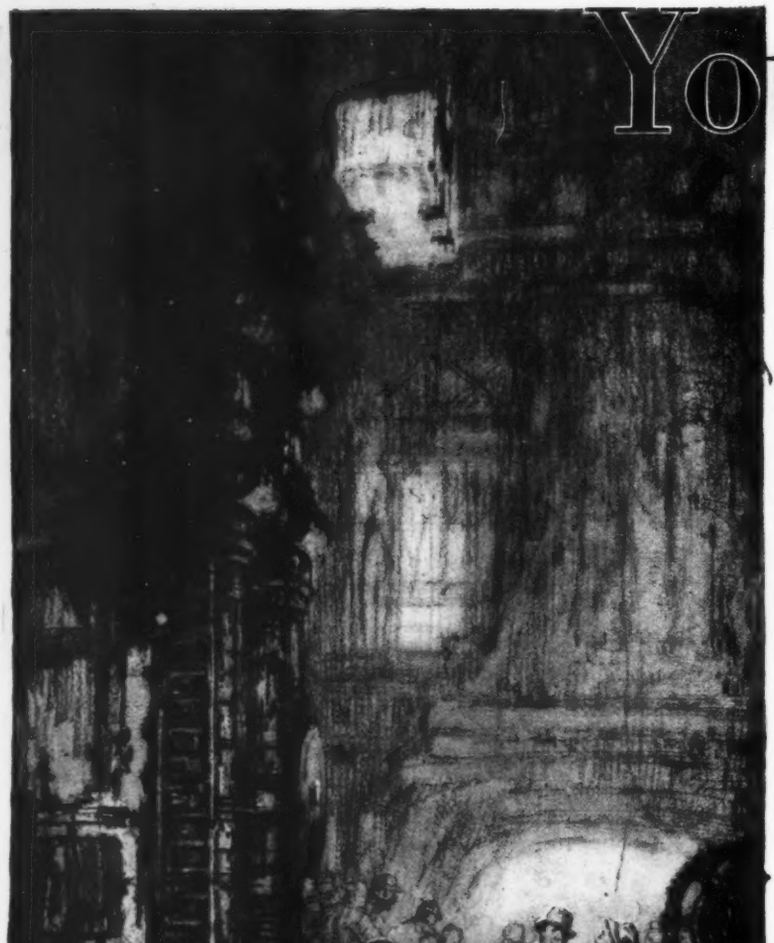
Lieut. C. B. Momsen, Navy diving expert, explains to Admiral Charles E. Hughes a new breathing apparatus he invented for rescue of sunken submarine crews. Tested in a diving bell (left), it enabled divers to descend 110 feet without ill effects.

The spectacular oil gusher at the left is said to be the largest ever seen in the United States. It was brought in recently in a new field in Winkler County, Tex. The first day it shot out 900 barrels an hour, which later increased to 1,200 barrels. The well's output is valued at $20,000 a day.

The U. S. Navy's new deep-sea diving bell devised for submarine rescue. A door in the side will fit on emergency doors to be placed in submarines, providing exit for men trapped undersea. Air pressure keeps water out. Here the bell is seen lashed to a tug. It holds eight men.

Newest radio motion picture machine, with Dr. Frank Conrad, the Westinghouse engineer who directed its development. The scanning disk, heart of the apparatus, is directly in front of him.

Another new system of color movies. The inventor, Frederick Thomas O'Grady, of Newark, N. J., holds in his hands the secret of the invention, a color filter in the form of a gelatin disk.



J. Orcutt Dustin, 2nd, millionaire's clothes and all, took a look at the dirty job that was offered him, grinned at the silent group that stood near by, and said "Let's go!"

Young Jim

By EDMUND M. LITTELL

A DISTINGUISHED oriental scholar, Prof. A. H. Sayce, has just revealed that the first iron ever used by man fell from the sky. It was iron extracted from meteorites. Ancient Babylonian documents more than 4,000 years old, recently unearthed, describe it as the "metal of heaven." In that far-off day began the romance of the "iron age" which has culminated in the annual production of almost 100,000,000 tons of steel. In this story the author of "Midge" and "Fire Shy" gives us another thrilling picture of the magic of flaming metal.

DIRT? The inside of a smokestack is a white porcelain tub compared to the cinder-tunnel that crawls beneath the soaking-pits of Midwest Steel. Heat? The breath from a stack's mouth is a cooling zephyr beside the blast that radiates from those incandescent rooms of hell. Yet J. Orcutt Dustin, 2nd, millionaire's clothes and all, took a look at the job that was offered him there, grinned at the silent group that stood near by, and said "Let's go!"

Sam Thurber was flabbergasted. He could find no word, either of denial or acceptance, only a grunt; and while the strides with which he took himself away from there were no more hurried than usual, he had the feeling of one who fled.

It was his own kingdom, too. His word was law at the soaking-pits, as well as at the gigantic clothes wringer of a blooming mill behind them, the huge hydraulic shears further back, and the expanse of chipping floor at the rear. He was boss of the whole shebang; the entire half-mile length of high-roofed building that resounded with the noises of cold steel working on hot was under his stubby thumb. Yet the "Let's go!" of J. Orcutt Dustin, 2nd, added consternation to amazement and caused him to flee.

Because he knew J. Orcutt Dustin, 2nd, just as every other man inside the high wire fence of Midwest Steel knew him. They all talked about him and his deeds, some of them with smiles, some of them with sneers. He was the son of James O. Dustin, the "Old Man" of Midwest Steel. To him would eventually come the fabulous wealth that five thousand men were creating in the trainsheds of buildings that made up the mill. The heir-apparent to a princely kingdom, and at the age of twenty-seven years the hardest work he had ever done, barring a brief period in uniform, was the steering of a polo pony or a high-powered automobile. Why, the talk was that he even had a hired man to help him put on his pants!

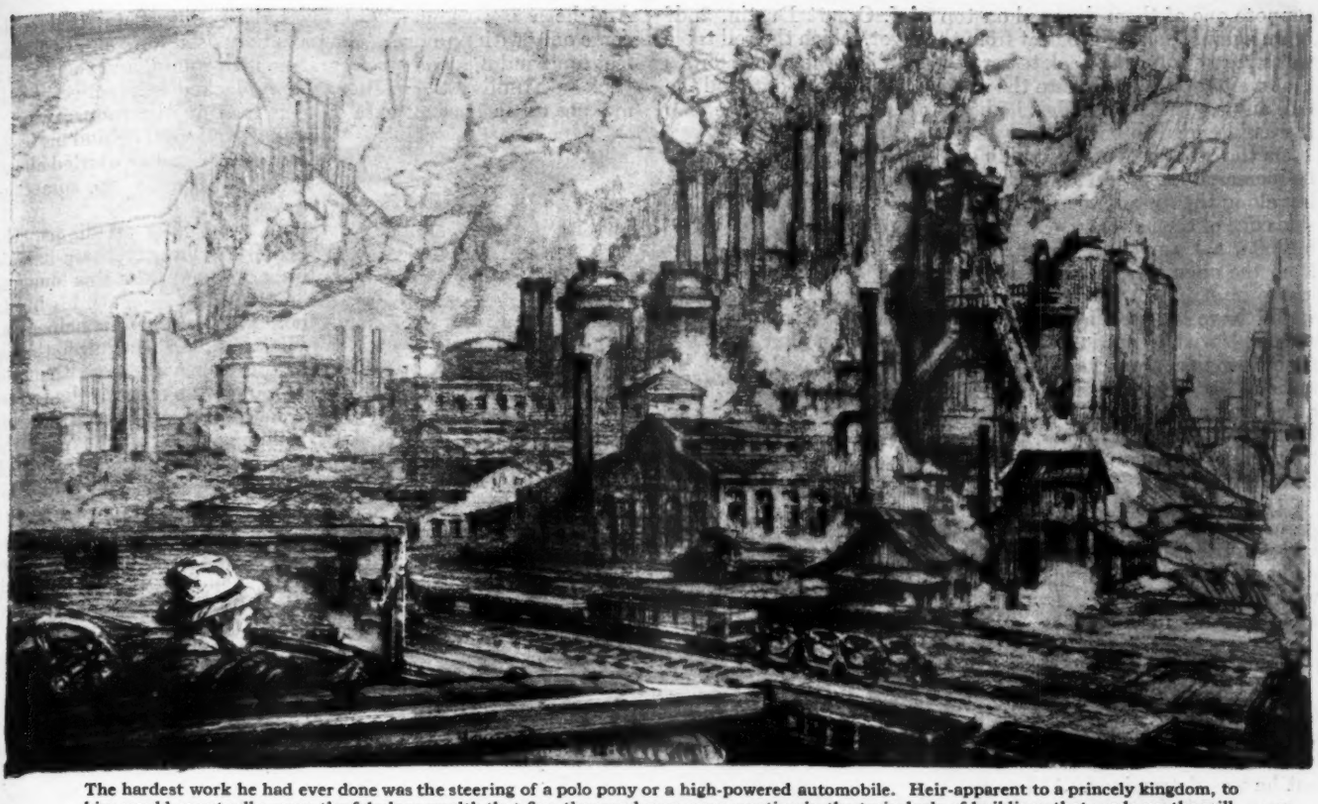
THAT was the man who had slipped himself into the dirtiest job in steel while Sam Thurber stood by, helpless. For Sam had aided and abetted him in his unsuspected purpose. Innocently, of course; otherwise it would not have happened. He had thought all the time that J. Orcutt was having one of his jokes.

As a matter of fact, Sam should have been suspicious from the first, for the very hour of their meeting had been an ominous sign. Eight A.M.—that was the hour when J. Orcutt Dustin, 2nd, was supposed to be hitting the high spots along the sleep route. Certainly he had never before appeared on the plant until well after noon. But Sam had been too busy to think about it at the time. The shift was changing and there was an important rolling to be taken care of. And their collision, just outside the door of his office-shanty that squatted in the front corner of his building, must have knocked the sense clear out of him.

"What the —" Sam began. "I *beg* your pardon!" said the other, and Sam finished his remark with a laugh. He would have recognized that voice in a darkened room. He liked the Old Man's son. The memory of his first inspection trip, as a wide-eyed boy with his hand in his father's, was still fresh in his memory. So he went on with a chuckle.

"Who got *you* up before breakfast?"

THEY made an oddly assorted pair as they stood there—a polished bar beside a rusty chunk of bloom. J. Orcutt was a six-foot specimen of the kind of young men who are seen mostly on the advertising pages of magazines, immaculate from felt-hatted head to shining brown toe; Sam resembled nothing so much as a five-foot chunk of one of his own square blooms, his workaday clothes and battered derby covered with the dust of his job and a stubble of beard on a face that appeared to have been gouged out by one of his chipper's chisels. But J. Orcutt was not one to notice such discrepancies, which was one of the reasons why Sam



The hardest work he had ever done was the steering of a polo pony or a high-powered automobile. Heir-apparent to a princely kingdom, to him would eventually come the fabulous wealth that five thousand men were creating in the trainsheds of buildings that made up the mill.

liked him. The brown eyes that always had a light of good humor dancing in them looked down upon him soberly and he replied, drawling, "Not a soul."

Then Sam pulled the line that always drew a grin. "Well, well! Than maybe you're out pickin' a job for yourself this mornin'," and waited for the grin that always came.

It did, together with— "How'd you guess it?" and their little game was on. Sam replied, with a look of great concern, to the greatly worried effect that he hoped J. Orcutt wouldn't take his job away from him. He had a family to support, and seventeen children, and—

"All right, I won't," J. Orcutt assured him. "I've decided, though, that you can't get along another day without my valuable services."

There, if Sam had only realized it, was where he should have side-stepped. But at the time he had concluded that the young man wanted to play a little longer, so he went on—the bigger fool he!

"WELL now, I appreciate that," he said with sober gratitude. "Let's see," thoughtfully. "We got a five-hundred-foot roll table that needs greasin' a couple o' times a day," with a mischievous glint in his upward glance, "or—by golly, I got it! Pete Reznik needs a helper on the soakin'-pits. How 'bout that?"

Pete Reznik always needed a helper on the soaking-pits. He himself had been on that man-killing job for eight long years and refused to take any other, but in all that time no man had ever been found who would stick there with him. They came and worked and faded away, sometimes after an hour and without asking for their time, sometimes after as long as a week. It was the hottest, dirtiest job in steel, and only Pete Reznik, the dried-up rack of skin and bones, had ever withstood its punishment. He stuck, working over the open mouths of those heat-soaked furnaces and inhaling their hellish breath as though he were asbestos, inside and out.

Just to imagine J. Orcutt Dustin, 2nd, working at such a job was enough to cause a laugh. To think of him doffing his swell clothes and wrapping a bandana around his face so that only his eyes were exposed, and those behind blue glasses, was stretching the imagination to the limit. To picture him standing over a half-opened pit and with poker and hoe shoving the mess of accumulated slag and scale down through the cinder-hole in the center of a floor ten feet below; to conceive him, sodden with sweat and caked with the clouds of dust that soared up on the wings of heat, closing the cinder-hole again and relining the floor with barrow-loads of coke breeze, then diving into the long, hot tunnel beneath and hauling away the stuff he had poked out—it was absolutely ridiculous!

So utterly nonsensical was the suggestion that when the lad replied with his slow-voiced—"All right, I don't care if I do," Sam Thurber roared with delight.

That was one of the things that made Sam—and not a few other men about the plant—like the lad so well: He always gave them amusement. No one expected him to do any work. Why should he? No one had had anything much to say when he had come home from college with his daddy's name parted in the middle, either. Well, not many. He was a gentleman, and always would be—the kind of a gentleman you read about. He liked to play, here and there and everywhere; he enjoyed living, and never did anything to be ashamed of. When he was at home he would visit the boys once or twice, and if any of them were hurt or had a sick one in his family there was always something nice from J. Orcutt. Nothing stuck-up about him, in other words, so if he wanted to play along with this little joke, let him. Such was the way Sam figured—then.

"Well," said he when he had had his laugh, "nothin' like startin' in right away, is there? Come on!"

So in our good-natured innocence do we hang ourselves—and with what consequences! For Sam actually led him around to the working side of the soaking-pits, figuring that J. Orcutt would take a look at the telephone booth of an office with its bench and its blackboard outside, chin a bit with the heater and his gang, then stroll on about his business. But he did not. His eyes were all for the scarecrow that was Pete Reznik working in the glow of light that shone up out of a pit, then he stripped off his coat and vest and said: "Let's go!"

SMALL wonder that consternation bestrode Sam Thurber as his short legs took him back along the floor of steel plates, down a six-foot flight of stairs, and across the heat-dried floor of earth beside the hot wall of the rearmost soaking-pit, office bound. It was bad enough to shoulder the ordinary cares of getting out the tonnage, but to have the Old Man's son on his pay roll besides——

He stopped automatically, warned not by the gong of the crane but by the blast of light that burst upward to illuminate the sooty girders overhead, and waited until the crane pincers had hoisted a seven-foot block of white-hot, scale-dripping steel from an opened soaking-pit, swung it across his path, and lowered it, small end front, onto the head end of the roll table. Those things were known to slip out of the tongs that gripped them; just

suppose one of them dropped on top of J. Orcutt Dustin, 2nd?

On again, ignoring the heat from the ingot, which the roll table was already bouncing back toward the shining, water-cooled rolls that waited to knead it into the snake of a bloom. Confound the lad, anyway! Why couldn't he have taken the thing as the joke it was intended to be?

On the other side of the building, with a clear path before him, he increased his pace. To his left, on the narrow gage track that lay along the foot of the five-hundred-foot wall that was the inside edge of the half-buried soaking-pits, a train of ingots fresh from the open hearth was waiting to be stripped. Normally he would have stopped and raised some hob with the stripper crane for not being at work, but now—an idea had seized him. In his office was a telephone, and, by the twenty-four chambers of hell that he bossed, he would get the Old Man on the other end of it!

"Gimme the Old Man," he growled into the mouthpiece, and when the sleepy voice of the night operator informed him with dignity that Mr. Dustin was not yet in his office—"I don't care where he is; I want him!"

James O. Dustin was hard to get at. Sam had to fight with two or three people in the great house on the other side of town, but he was determined. At last a gruff "What d'you want?" came over the wire and he spoke his piece as gruffly.

"I want you to come out here an' take your boy off my hands," he barked, unmindful of the position of the man he ordered around.

"What for?"

"He's took himself a job, an' I don't want him."

"Why not?"

Sam Thurber lost what little patience he had left. "I'm runnin' a bloomin' mill, Jim Dustin!" He snapped it as one man to another, not as employee to boss. "I'm busy gettin' out tonnage; I ain't got time to be watchin' any kid o' yours. You come out here an' get him!"

"You gave him the job, didn't you?"

"No, I didn't. I showed it to him."

"What job is it?"

"Cinder monkey."

"And he took it?"

"He said 'Let's go!' the damn' fool, an'——"

"Well, let him go," was the decision of the voice that made men jump, and the click of a severed connection shut off a deep-chested chuckle.

Bang! A receiver was slammed onto its hook as though it were a club descending upon a head. They were both alike, those unmentionable Dustins. Father and son—dog-gone his impertinence!—they took what they wanted. The nerve of him, walking into his place and slipping it over on him like—— He stopped abruptly. Maybe it was still a joke. Maybe J. Orcutt had taken up his coat and left. Sam Thurber streaked hopefully back over the familiar roundabout path.

It was no joke. It was a serious business, and J. Orcutt Dustin, 2nd, was working at it. The heavy brick ceiling of pit Number Seven had been pulled back a few feet on its four wheels and there, in the glow from the partially cooled furnace beneath, were two figures, not one.

IT WAS easy to tell which was which. Pete Reznik was dressed for the job, J. Orcutt Dustin was not. Blue glasses, yes; but there the resemblance ceased. The handkerchief he wore over his face was white, or showed signs of having been; the same applied to his shirt. From the waist down he was invisible, for they worked over the top of a corrugated iron shield designed to deflect a little of the heat that gnawed at them, but Sam could imagine how those once immaculate trousers and shoes looked.

Jim jumped up like a cat, prepared for the next move. He stood over Slug's still form, panting: "Come on; get up!"

And he was working—hard. Not deftly like Pete; that could come only with practice. The tools they used were almost fifteen feet long and made of steel bars one inch round, and there was a trick in handling them. But what he lacked in practice he was making up in energy, with Pete indicating the proper way.

"Papa's boy—workin'!" A heavy voice jeered behind his back, and Sam Thurber whirled about. "'Til he thinks up somethin' new to do!"

It was Slug Williams, the heater, a brawny, ham-handed hulk of a man who was lounging on the bench beneath his blackboard with one of his helpers beside him. Sam recognized the situation he feared more than the slipping of an ingot or the terrors of hell fires beyond control. Slug Williams had come from the open hearth, fired by Jock Campbell because he preferred loafing and talking to second helping, and Sam had taken him on because he knew a little something about steel. He had developed into a first-class heater, too. His blackboard was always an up-to-the-minute record of what was in his pits and when it had been charged; he knew without being told just how to treat each heat of ingots that was scheduled. If they were soft steel, newly cast at the open hearth, stick 'em in a hot furnace and let 'em freeze through quick; if they were high carbon give 'em a slow heat so that the solidification of the ingot would not set up disastrous internal strains; if they were cold ingots from the bank, charge 'em in a cool furnace and bring 'em up slow. All the wrinkles were his, and Slim Jackson, the screw-down man in charge of the bloomer, swore by him and his works because never once had he had to send an ingot back for reheating. But he was a sneerer, one of those men who hated all J. Orcutt Dustins, and in a flash Sam was standing over him with fury in his eyes.

"Yes, he's workin'," he growled. "With his hands, an' I ain't ever seen you do anything but wear out the seat o' your pants! An' he'll keep on workin' or he'll quit—whatever he wants to do, without anything out o' you; get me?"

Slug Williams shifted on his bench and looked away across the curved roofs of his soaking-pits. "Aw, what's——"

"You heard me," barked Sam. "Keep your hands to yourself, or——"

A SULKY grumble from Slug, who could have picked up his boss and tossed him into a pit if he had been so inclined, and Sam made the threat clear.

"What's it goin' to be—keep your job, or start the bully stuff?"

Four shrill toots cut across the clamor that filled the building—a call for Sam, from the whistle of Slim Jackson. Sam was wanted in the pulpit behind the bloomer—and reminded of the errand he had set out to do before interruption by a collision. But he ignored it for the moment, as he did the scraping of feet on the gritty floor behind him, and waited for Slug to take his choice.

Then an unmistakable voice broke the silence that gripped them: "I'm looking for the coke breeze," it drawled. "Do you know where it is?"

J. Orcutt, and Sam postponed an issue and faced around. It doesn't take long, a cinder-cleaning job, especially when you have joined in after it has been started; but it can make a black ruin of anyone. Under different circumstances Sam might have had a good laugh at what a few minutes can do, but it was no time for laughter then; instead he acted the superintendent.

"Slug Williams here is your boss," was his belated introduction. "Slug, this is——" he stopped, uncertain as to how to name the Old Man's son.

"Jim is my name," the blackened, (*Continued on page 158*)

How would you feel and act if, every time you set foot out of doors, you faced a battery of cameramen like this? It's a price men must pay for being famous.

Camera Reveals Surprising Facts About Great Men

New Tests Show How to Have Your Picture Taken—Kinks for Camouflaging Big Feet or Shortening a Long Nose

By CARL HELM

"HE WON'T get my vote; I don't like his looks."

How many times, in the last few months, have you heard that said of one or the other of the candidates for the Presidency of the United States?

These are days, thanks to the motion picture, radio, and the news photographer, when we don't have to go to see or hear Presidential candidates. They come to us. From afar, we not only hear their voices, but we see their faces, study their changing expressions, note their actions and demeanor, even their little eccentricities. As a result, the idea has grown up that character and ability may be judged by photographs; that the camera is at once an exact measure of the greatness of famous men and the acid test of their relations with the public. Almost any photographer will tell you that he can read the inner lives of the great and the near-great from their appearance before the camera.

Is this idea correct?

Not long ago two psychologists of Wesleyan University, Dr. Carney Landis and L. W. Phelps, undertook by scientific tests to determine just how much a man can be judged by his photographs. From a large university class which graduated twenty-five years ago, they selected the twenty most successful lawyers, doctors, teachers, engineers, and business men; also the twenty least successful. Then they obtained photographs of all forty men at graduation, and of the same men twenty-five years later. The photographs were shown to a group of psychology students, who were asked to tell from the pictures which were the successful men, and what calling each had followed.

Edison and Ford "facing the guns" together. Ford objects to profiles, but this shot caught him.

Cornered on deck. But John D. Rockefeller, Jr., just smiles, as usual when the photographers ask him to "Hold it, please!"

The result was almost complete disagreement in every case. A highly successful engineer, for instance, was taken for an unsuccessful preacher; a school teacher for a prosperous banker. The only conclusion the experimenters could draw was that photographs reveal neither a man's real character nor his ability; that a photograph included with an application for a job, for example, will give an employer no accurate idea of the applicant's fitness.

ONE reason for this, perhaps, is that the ordeal of facing a camera very often definitely alters a man's customary behavior, at least temporarily, and so makes him appear to be what he is not.

As candidate for President, Alfred E. Smith has grown serious before the camera. But having a picture taken never worries him.

Let's look at the Presidential candidates as they face the camera's eye. Herbert Hoover is the despair of the Washington photographers. Though noted for his versatility, he has just one pose for the camera—looking straight at it with an almost expressionless face. Hence his photographs are almost identical. He seldom displays more than the faintest suggestion of a smile when he poses for the cameraman. He dislikes to be photographed in full profile.

IN CONTRAST, Alfred E. Smith is not in the least concerned about having his picture taken. He has been in the public eye too long to let the cameras disturb him. Coming up through the political ranks, "Al" Smith always had a wide smile, almost a grin, when photographers came. But when he began being talked of for President, the Governor became more sedate and serious. He is willing to be photographed in any position but the profile. His favorite pose is full face. He prefers to be "shot" while he is talking, to be shown "doing something besides having a picture taken."

Suppose that every time you set foot out of doors a horde of men were waiting to take your picture. To the average man a visit to the photographer is as painful as a session with the dentist. You can imagine, then, the state of your nerves if you had to face a camera every day in the week.

"Look this way, please!"

"Take off your hat!"

"Now, give us a smile!"

"Hold it, please!"

This is part of the price great men pay for being famous, and it is enough to shatter the disposition and poise even of men with iron nerve. Not long ago the headlines reported of Colonel Lindbergh that he was "nervous and needed a rest." No little part of this "nervousness," his friends say, was caused by the camera. He hates to be photographed. He would rather fly through six snowstorms, they will tell you, than face a battery of photographers.

The best photographs of "Lindy" were those snapped at the flying field in Paris just after he landed in his epochal flight. They caught him unaware, smiling and unselfconscious. But when he got back to New York and photographers began hounding him, the smile left his face. It was only a natural embarrassment, but it changed him almost overnight from a carefree youth into a staid and formal celebrity. He began setting his face in sterner lines. Compare those first photos of the boyish Captain Lindbergh with those of the Colonel Lindbergh of today!

The most photographed man in the United States probably is Mayor James J. Walker, of New York. He enjoys being photographed—perhaps he is the only celebrity who does. His every movement, the photographers say, is an unstudied pose in itself. And he's always smiling.

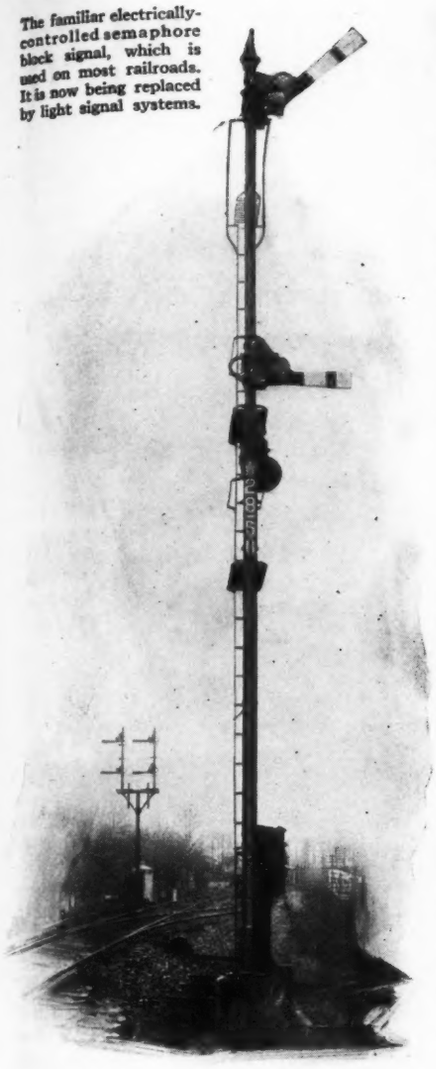
President Coolidge is a "difficult subject," and Herbert Hoover has just one pose for the camera.

He has one little eccentricity—he doesn't like to be photographed bare-headed. His hair is sparse.

Edward, Prince of Wales, holds the doubtful honor of being the most photographed man in the world. He is the only member of royalty, too, who is consistently photographed while falling off a horse! He is selfconscious when he sits down to a posed, formal photograph. But, like Mayor Walker, he takes a lively interest in the proceedings when a crowd of American news photographers surround him, and is smilingly gay about it. On his last visit to the United States one photographer shouted, "Hey, Prince! Take off your cap!" The Prince complied, laughing. "I don't like that cap myself," he shouted back. "Go on and shoot!"

Ever see a photograph of Sir Thomas Lipton without a merry smile? The famous yachtsman may possibly be grouchy at times, but the camera never tells.

KING ALBERT, of Belgium, is the easiest photographed of royalty. He sits for his picture as if he were enjoying himself. The credit goes to his gracious Queen, Elizabeth, herself a camera enthusiast. She has coached him in the trick of being at his ease before the camera, and has put her preachings into practice by taking innumerable pictures of him with her own little kodak. (*Continued on page 166*)



The familiar electrically-controlled semaphore block signal, which is used on most railroads. It is now being replaced by light signal systems.

Safer Signals for Railways

New Lamps That Flash Warnings in Daytime as Well as at Night Replacing Semaphores

By CHARLES ADLER

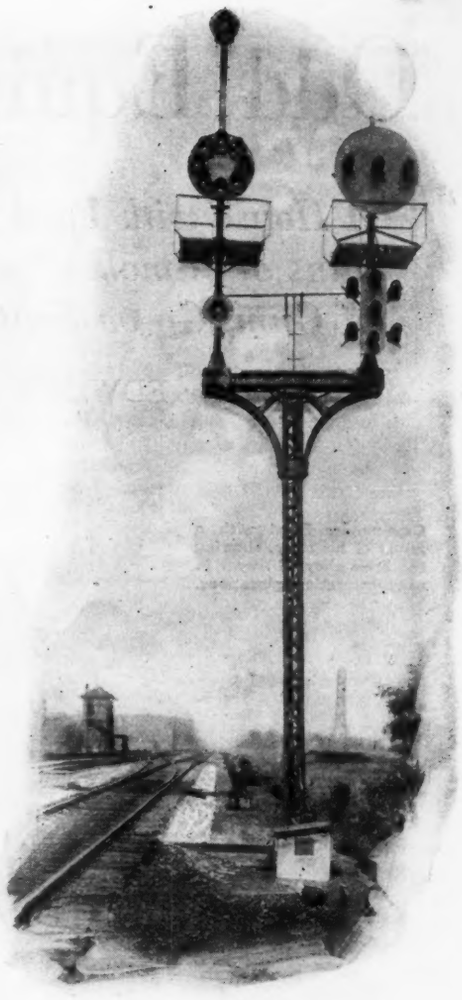
A FAIRYLAND of blinking color flashes—that is the fifty-mile stretch of track between Attica Junction and Deshler, Ohio, where the Baltimore and Ohio Railroad has just installed the latest in railway signal systems. Vertical bands of green light speed fast expresses on their way. Slanting lines of amber counsel caution, and red crossbars halt puffing locals.

These new "color-position-light" signals, electric-lighted warnings visible in brigb est sunshine and darkest night, are intended to remove forever the possibility that an engineer may mistake their meaning. They represent the latest step in the safe control and dispatch of trains by visible indicators.

When hand operated semaphore signals with painted, moving arms, mounted upon a tower, were introduced in 1841, they were regarded as a tremendous step forward for safety. But they were unsuited to control the fast through trains of today, where a signal operator's failure might cause a frightful wreck. Automatic block signals, now used on all but a few local and suburban lines, removed the menace of the careless signalman, and made the signal system practically infallible. But can the engineer of a train see the signals?

Strong colored electric lights with powerful reflectors, tried out on several roads, have proved to be visible by day and night, and dispense entirely with the moving semaphore arm.

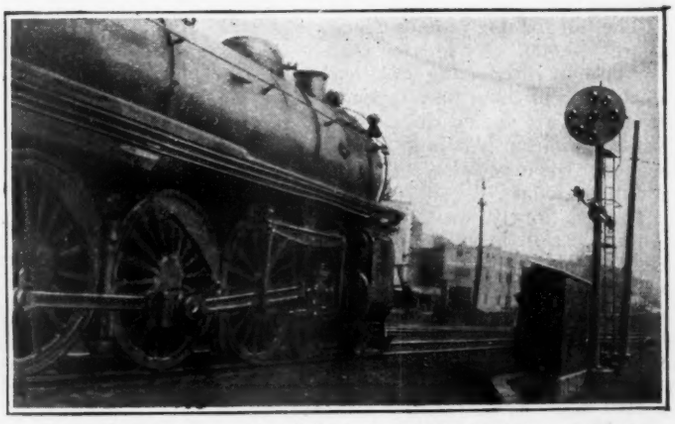
Meanwhile the Pennsylvania Railroad has devised another ingenious substitute for moving semaphores. Rows of powerful amber lights arranged on a black circular background replace the swinging arm, and may be flashed on in different groups, giving this type its name of "position-light" signal. Three lamps in a horizontal row mean "danger" when illuminated, corresponding to the "danger" position of the older semaphore. Lighting three lamps in a vertical row signals "clear," and a slanting row of lamps designates caution. Another diagonal row of lamps opposite to the last gives a fourth signal not possible with the semaphore arm. It is called a "permissive" signal, and allows an engineer to enter a block knowing a train is ahead, and is frequently used when a relief locomotive arrives to couple to the rear of a standing train.



This signal, combining both the position and colored light systems, cannot be misread.

In the latest type of signal as used by the Baltimore and Ohio Railroad, colored lamps and the position-light are combined to supplement each other and make the signal unmistakable. Two brilliant red lamps side by side warn of danger ahead. Green lights, one over the other, tell of a clear track; but if the lights are amber, and in a slanting row, the signal is for caution. Clear white lights in the opposite slanting position give the "permissive" signal.

The color as well as the position of these lights on the Baltimore and Ohio Railroad tell the engineer whether or not the track ahead is clear.

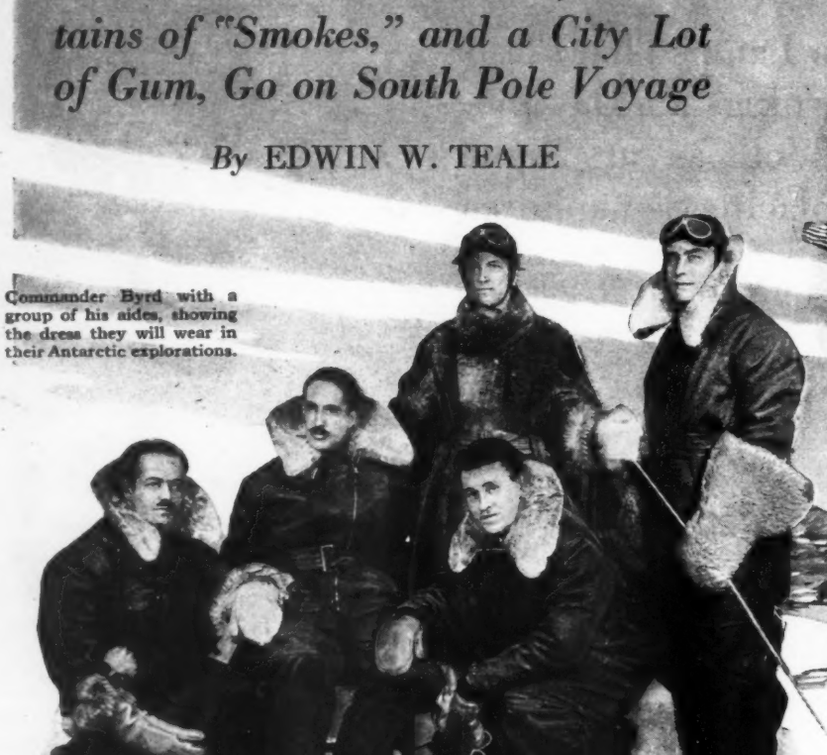


The position of three amber lights in vertical, horizontal, or slanting rows conveys a message to engineers on the Pennsylvania Railroad.

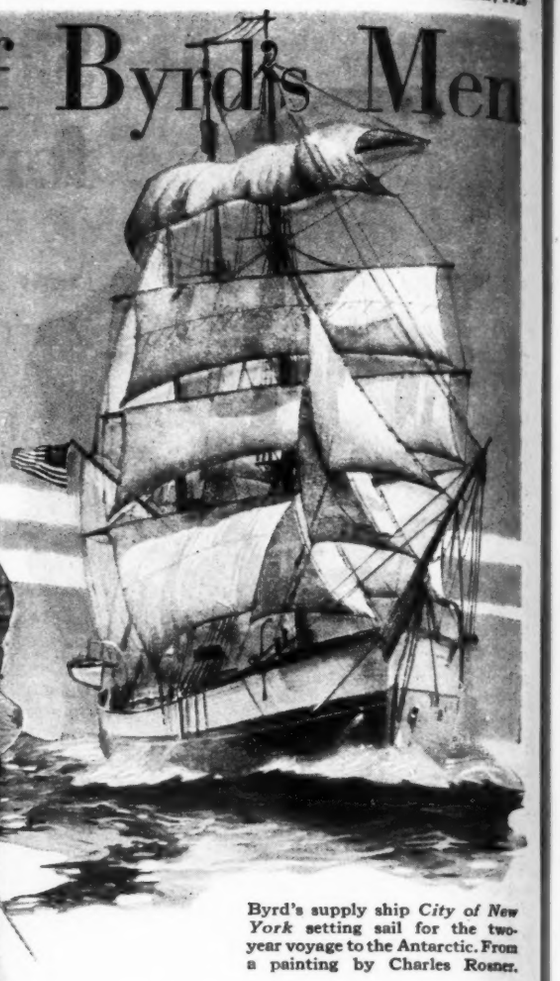
Odd Equipment of Byrd's Men

A House with Food Walls; Mountains of "Smokes," and a City Lot of Gum, Go on South Pole Voyage

By EDWIN W. TEALE



Commander Byrd with a group of his aides, showing the dress they will wear in their Antarctic explorations.



Byrd's supply ship *City of New York* setting sail for the two-year voyage to the Antarctic. From a painting by Charles Rosner.

WHEN Commander Byrd's flagship, the bark *City of New York*, with its gleaming white hull and orange masts slid out of New York harbor recently for a two-year visit to the Antarctic, it carried the first consignment of the most expensive and complete equipment ever provided for a voyage of exploration. The *Eleanor Bolling*, second ship, took aboard the rest. It includes the latest inventions of science, devices to produce artificial sunshine, and even an electric ice-making machine!

The bill for dog biscuits alone, nearly $8,000, was greater than the cost of discovering America! Forty tons of them were taken to feed Byrd's 100 sled dogs. The value of all supplies and equipment for the expedition is close to a million dollars.

On the lonely wastes of the Antarctic a little village of some eighty inhabitants will be set up, with houses laid out on a street, gasoline engines supplying electricity for lights, and with a public library of 2,000 volumes!

The half-dozen houses are being transported in sections. They are specially designed for warmth in a land where sixty degrees below zero is common. Each of their tiny windows has three panes of glass with an insulating air space between, and there are two doors for every entrance, working like canal locks so one cannot be opened until the other is closed. The main walls are formed of a number of thicknesses of wood with air space between and special insulating layers of kapok, a fiber one seventh the weight of cork, obtained from pods of the tropical Ceiba tree.

Byrd will use this remarkable sextant camera to locate the South Pole. Photographing the sun, it records, by the sun's position, the exact location of operator when he snaps the shutter.

When these houses are set up at the expedition's main base, they will be sunk four feet into the ice. As further protection against gales that sometimes attain a velocity of two miles a minute, heavy straps over the roof will anchor them. In winter, deep snow banks will give added shelter. The men will communicate between buildings through tunnels in the ice.

Another building—it's like a fairy tale—will be a house of food in which the men will devour the walls, starting from the inside and eating out!

THE explanation is this. All the canned goods have been packed neatly in small boxes devised to be opened from the side by snipping wires that bind it and opening a flap. All the boxes are the same size. When the expedition reaches its base in the Antarctic, planks, laid on the ice, will form the foundation upon which brick walls will rise, each "brick" being a box of canned food. The storehouse, thus formed, will be large enough to shelter one of Byrd's airplanes.

The flaps all will face inward so the contents of the boxes will be consumed gradually. Wooden posts in the box corners will hold them rigid after the

cans have been removed. By piling snow against the outside, the empty boxes are expected to form a wall rigid enough to support heavy tarpaulin forming the roof.

The fact that the food must pass through extremes of temperature presented special problems in packing. Before it reaches the Antarctic it must encounter the heat of the equator; hence the electric ice machine. All tin cans are coated with a special paint developed to resist rust in extremes of temperature. Maroon was the color chosen because against it the slightest scratch that may invite rust shows up and can be given a daub of paint.

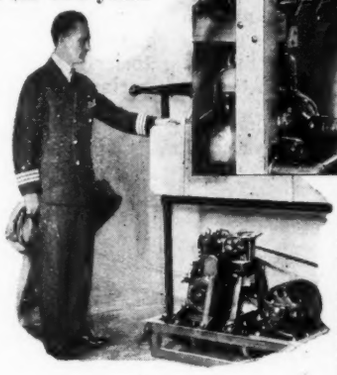
THE mountain of food, taken to support about eighty men for two years in the Antarctic, includes twenty-eight tons of meat, twelve tons of potatoes, seventeen tons of flour, half a ton of apple sauce. The onions taken by the explorers weigh 1,070 pounds more than Lindbergh's famous monoplane, *The Spirit of St. Louis!* Twelve hundred and fifty cases of cheese also are making the trip. Dried fruit and vegetables total nine tons; jam, jelly, and marmalade, another ton. The morning cup of coffee will be provided from a 4,500-pound supply. It will be flavored with milk from a two-ton supply.

Three tons of beans will help make the walls of the storehouse, besides a ton and a half of kippered herring, 400 pounds of mince meat, 100 gallons of honey, more than two tons of cereals, and 1,000 packages of gelatine. Nearly 1,200 pounds of cookies will help top off the meals. For seasoning, there are a ton of salt, more than sixty pounds of pepper, and 175 pounds of assorted spices.

A ton of tobacco goes along to provide relief from the strain of the long winter. With it were shipped eighty-four new pipes. And 500,000 cigarettes. Piled on top of each other, the cartons containing this mountain of "smokes" would reach up to the tenth story of an average office building!

IF CHEWING gum were used to pave the ground about their camp, Byrd's party would have enough along to cover a city lot; their supply includes 70,000 sticks. This in addition to two and a half tons of candy!

After Byrd and his men return, it should be easy for later explorers to tell where they have been by a litter of used razor blades. Sixty razors and 1,200 packets of blades went with them. Nor did Commander Byrd forget his toothbrush, and thirty dozen more for his men. He took along enough soap to give the entire standing army of the United States a thorough scrubbing.



Above: L. V. Berkner, chief radio operator, trying out the *City of New York's* transmitter. Left: Byrd inspecting electric refrigerator which will preserve food on the trip.

The party will not lack for amusement. There are thirty radio receiving sets—from small three-tube portables to eight-tube super-heterodynes. And when reception is poor in the Antarctic, the men still have three camp phonographs with a collection of more than a hundred records. The musically inclined also may strum their own banjos and ukuleles, or play a small piano included in the equipment. Besides the library of books, there is a movie projector and a film library of fifty reels for impromptu picture shows.

THOUGH powerful radio transmitters—twenty of them—should keep the explorers in touch with home, Commander Byrd has taken along 60,000 sheets of writing paper.

If anyone gets sick, the medicine kit, weighing more than a ton, contains among other things, a gallon and a half of cod liver oil and twenty-five pounds of epsom salts. Thirty assorted varieties of illness are guarded against by a supply of 50,000 tablets. Lest tetanus, diphtheria, pneumonia or scarlet fever invade the camp, 300 packages of antitoxin for these maladies went into the outfit. No one's health should suffer for lack of sunlight during the long Polar night, for a huge ultra-violet ray machine will bathe ten men at once in artificial sunshine.

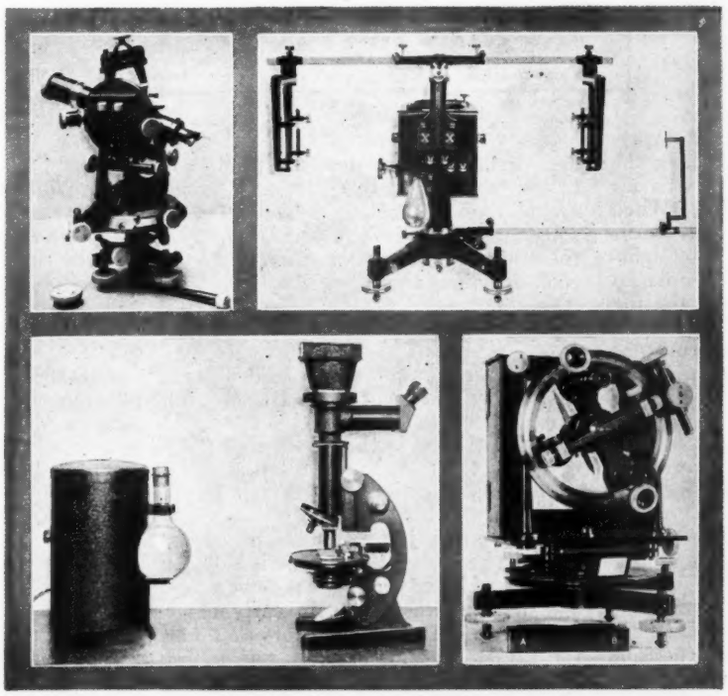
New sounding device which will trace the coast line of the Antarctic continent and plumb ocean depths.

When Byrd and his men leave their village on exploring trips toward the Pole, they will draw upon still other equipment. Tents of airplane cloth are dyed burnt orange, for warmth and visibility. A new type of portable gasoline stove will cook a meal for six men in an hour, providing water for cooking simply by melting chunks of ice. Of course, the equipment includes spare parts for the airplanes that will play an important part in exploration.

EVERY man has a camera and films. In addition an automatic mapping camera will chart unknown areas from the air. One remarkable camera, a photographic sextant, will record the exact location of the operator when he snaps the shutter, by the sun's position. It will be used to locate the South Pole.

Two motion picture photographers in the party are prepared with twenty-eight miles of movie film—enough to keep a camera clicking for thirty hours.

(*Continued on page 169*)



Scientific instruments of the expedition. Top, left to right: Theodolite for astronomical observations; variometer for measuring earth's magnetic variations. Bottom, left to right: Photomicroscope to picture organic life in Antarctic waters; dip circle, an instrument for measuring earth's magnetic field at the South Pole.

Latest Gifts of Research

Aluminum Plating at Last

"BILLIONS of dollars" is the value placed upon the recent discovery, at the University of Illinois, of a method of coating metals with aluminum by electroplating. As announced by Prof. D. B. Keyes, of the university faculty, it solves a problem which has baffled experimenters for years—ever since the electrochemical process of extracting aluminum was discovered, back in 1885.

So many are the uses to which aluminum has been applied in industry, that it has come to be known as "the modern metal." Aluminum pots and pans that refuse to rust are indispensable to every up-to-date housewife. Every engineer recognizes the importance of lightweight aluminum parts in automobiles and airplane engines and so on.

Yet, pure aluminum lacks strength and toughness. It dents and nicks easily. This weakness has limited its usefulness, especially in mechanical construction.

But now, with aluminum plating made practicable, steel or tough aluminum alloys can be given a coat of the corrosion-resisting metal.

"Pure aluminum will withstand the corrosive action of most concentrated acids and all common sulphur compounds," explains Prof. Keyes. "These agents cost industry today billions of dollars due to their intense corrosive action."

Raindrops from Smoke

DUST of the air—even coal smoke—eventually may come into wide practical use in scientific rain making.

Such was the recent assertion of Prof. C. F. Knipp, a chemist of the University of Illinois, who demonstrated how, with the aid of dust, experimenters now can make rain fall in the laboratory. A vessel is filled with air moistened to the saturation point. When this air is expanded, the moisture turns to fog. Then dust is introduced by lighting a match and allowing the smoke to filter into the vessel. Instantly the fog turns to raindrops.

While the process is in the experimental stage, "eventually it may be done in the open," said Prof. Knipp. "If the air over New York City were at the saturation point, and we wanted rain, all we would have to do would be to blow some of the city smoke into the air and we would have rain."

Women Win Clothing Test

WHICH wear more sensible clothes, men or women?

An answer to the old disputed question at last has been supplied by scientific laboratory experiment.

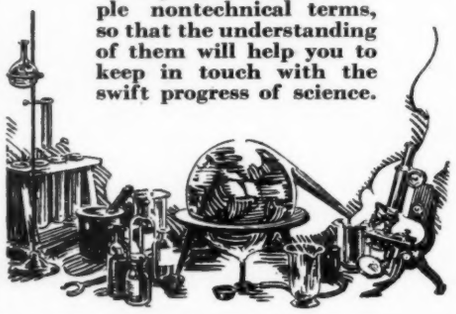
And it is all in favor of the women.

The scientist who tackled this ticklish test is the noted German hygienist, Dr. Ernst Friedberger. He found the answer by placing thermometers and other precision instruments beneath the clothing of both men and women, and so measured the temperature and humidity next to their skins. In addition, he measured the amount of health-giving ultra-violet light which penetrated their garments, by means of sensitized paper inserted beneath their underthings.

He found that the temperature next to a woman's skin is as much as ten degrees lower than next to a man's, and that the humidity is from a third to a half less.

"The average modern man," he concludes, "spends most of his life, winter and summer, in the debilitating climate of the tropics. Only his face and hands are allowed to stick out into healthier surroundings. The average woman, on the other hand, lives in a climate like the cool, dry air of the Alps."

ON THESE pages each month the important new discoveries, inventions, and theories of science are briefly described and illustrated. Most of them in their useful applications have a direct bearing on the everyday lives of all of us. And they are explained here in simple nontechnical terms, so that the understanding of them will help you to keep in touch with the swift progress of science.



The Healthiest Age Found

FOR more than two years, 8,000 men, women, and children of Hagerstown, Md., have been the subjects of the first study of its kind in the world, an investigation by the U. S. Public Health Service to learn new facts about the relation of age to physical fitness.

The records, just made public, reveal that the healthiest time of life is between the ages of twenty and twenty-five years. The most illness comes in early childhood, with old age next. More than half the illnesses at all ages, it was found, were respiratory ailments, chief among which was the common cold.

Sickness costs the average person in the United States $31.08 a year, or $134.68 per family, according to recent estimates announced by Homer Folks, Vice Chairman of the Public Health Council of New York State. The total loss of earning power in the United States, due to illness, is figured at $15,000,000,000.

Atom Thickness Measured!

FILMS of metal so thin that they are utterly invisible to the human eye have not only been produced, but also measured, in the Bell Telephone Laboratories at New York City. In recent experiments under the direction of H. E. Ives, to improve the design of photo-electric cells for television, layers of a light-sensitive metal known as rubidium, of various thinness, were deposited inside of glass tubes. When best results were obtained with one particular film, the task remained to measure it.

Ordinary methods were out of the question, for the metal particles were beyond the range of the most powerful microscopes. An entirely new method was devised. Polarized light, which is ordinary light shot through a grating that changes a "round" beam into a flat one like tooth paste issuing from a tube, is twisted in passing through the metal rubidium; and the amount of twist depends upon the metal's thickness. By using polarized light, the experimenters found the thickness of their best metal film to be just one atom, or about 1/500,000,000 of an inch.

Finds Earth Cooling

THE earth is cooling off, according to the theory recently advanced by Dr. William Bowie, Chief of the Division of Geodesy, U. S. Coast and Geodetic Survey. Millions of years from now, he believes, our world will be a lifeless frozen ball.

A billion and a half years ago, he says, the earth's temperature was just below the boiling point of water, 212 degrees F. Today the average is about fifty degrees F. Thus he estimates that the earth is cooling at the rate of about two degrees F. every 16,000,000 years.

"Summers on the American continent, as in other temperate zones," he declared, "are going to be imperceptibly cooler as the years go by."

Developing Powdered Milk

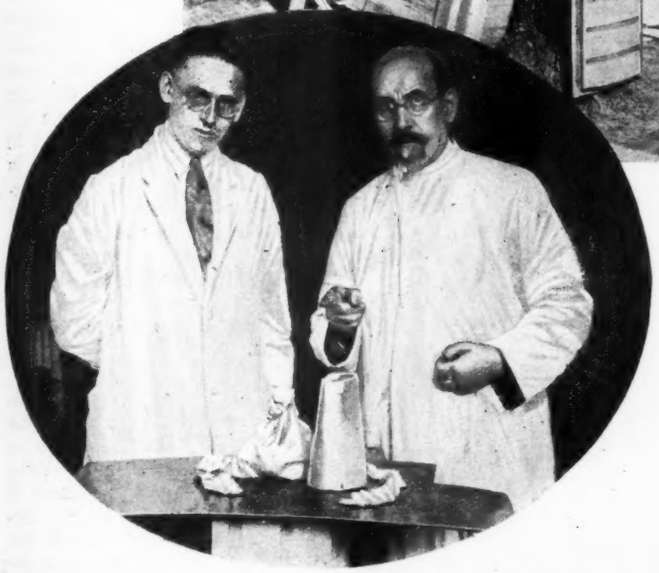
MILK bottles soon may disappear, along with bottling machines and the daily rounds of milk wagons.

According to Prof. Victor E. LaMer, of Columbia University, chemists are at work to produce milk in powdered form to simplify the problem and save costs of distribution. And Dr. H. E. Barnard, consulting chemist of Indianapolis, Ind., states that powdered milk already is being marketed in limited quantities.

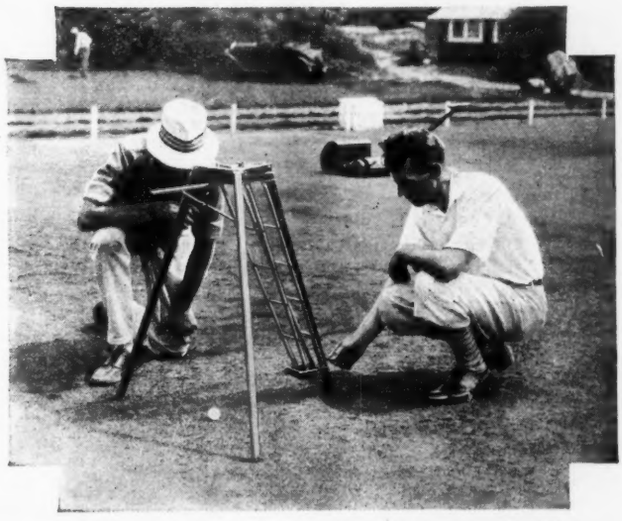
Fireproof Paper Invented—X-Rays Find Flaws In Trees—Useful New Laboratory Discoveries

The latest use for the X-ray is to peer into the heart of a tree. With the new apparatus shown at the right, perfected by the Eastman Kodak Company, experts determine the extent of decay, thus safeguarding against damage from falling trees or telegraph poles. The apparatus also is useful for inspecting wooden parts of airplanes.

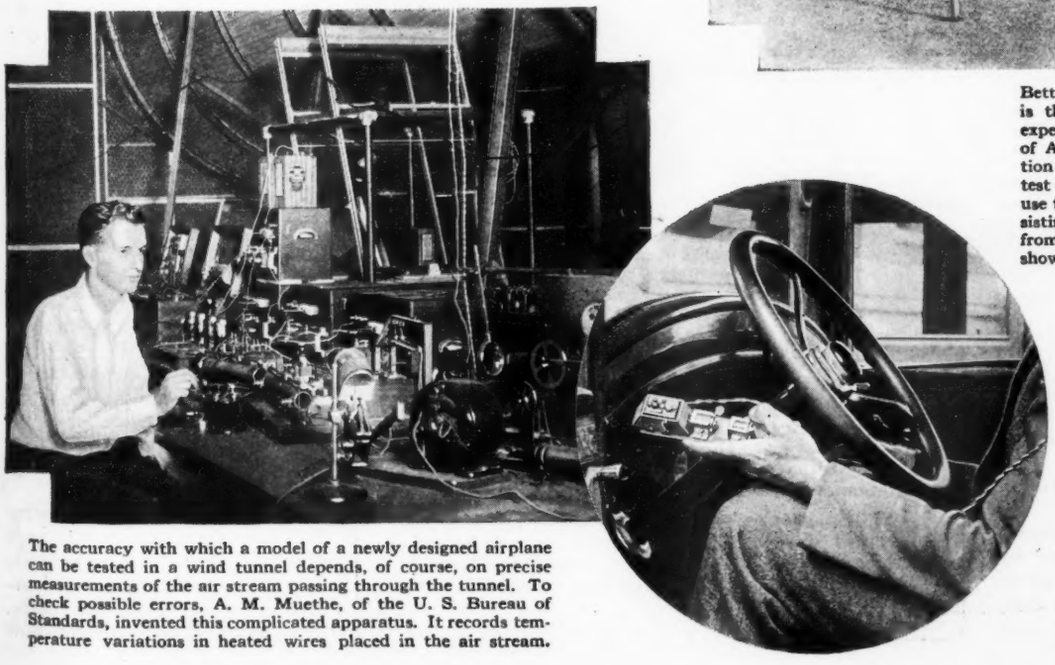
For his work in studying the new disease of tularaemia, or rabbit fever, Dr. Edward Francis of the U. S. Public Health Service has been awarded the gold medal of the American Medical Association. Here he is in his laboratory busy with his experiments.



Books and wrapping paper that won't burn, even paper clothes for firemen, are possibilities foreseen from a method of making fireproof paper recently discovered by Franz Franck, a Berlin chemist (right). Here he is displaying the new paper which, in experiments, was not even scorched when held over a blast lamp hot enough to melt glass.



Better putting greens for golfers is the aim of experiments by experts of the U. S. Department of Agriculture under the direction of Dr. John Montieth. To test various kinds of grass, they use this mechanical putter, consisting of a pendulum swung from a tripod. The ball's roll shows resistance of the grass.



The accuracy with which a model of a newly designed airplane can be tested in a wind tunnel depends, of course, on precise measurements of the air stream passing through the tunnel. To check possible errors, A. M. Muethe, of the U. S. Bureau of Standards, invented this complicated apparatus. It records temperature variations in heated wires placed in the air stream.

That twenty percent of automobile headlights are too bright is the finding of Dr. H. C. Dickinson, of the U. S. Bureau of Standards. With a small photometer (left) attached to his car, he measured the glare of all headlights encountered during a recent journey across the continent.

Trapped 350 Feet Underground

Miners Buried Alive Deep in Poisonous Tomb Saved by Uncle Sam's Trained Rescue Crews—How New Inventions Help to Safeguard the Lives of a Million Workers

By BOYDEN SPARKES

AMERICAN breakfast tables were saddened one morning recently by news of four mine disasters. A total of 223 lives had been snuffed out in four days as an incident of the extraction of fuel and metal vital to the operation of our complex system of civilization.

Far underground in a coal mine at Mather, Pennsylvania, an explosion had transformed the families of 195 miners into widows and orphans; another explosion in the depths of a coal mine at Bluefields, West Virginia, had killed seventeen men; seven others had died horribly in a mine at Harlan, Kentucky; and four men had been crushed beneath tons of rock and ore in a cave-in deep in a shaft sunk into copper deposits at Kimberly, Nevada.

APPALLING as were these disasters, they were only a small part of a greater tragedy. That tragedy is the loss of more than 2,500 lives in the American mines each year; but even that fearful total would be many times greater were it not for one life-saving agency of our Government of which most Americans are little aware—the mine Rescue Service of the U. S. Bureau of Mines.

Just the other day, hundreds of trained men from mines in all parts of the country assembled at Butte, Mont., to demonstrate their skill in saving unfortunate comrades entombed hundreds of feet beneath the earth's surface. The event was the International First Aid and Mine Rescue Contest, staged annually under Government auspices. There trained first aid teams displayed the latest scientific practices of treating injuries and of reviving half suffocated victims. There, too, mine rescue teams, wearing gas masks and oxygen breathing apparatus, vied with one another in solving problems which might be encountered in the event of disastrous mine explosions or fires.

Living entombment is one of the most dreaded fates. And every one of a million American miners is always shadowed by the chance of being buried alive. But that is not their only danger.

Death may strike from above. Rockfalls from mine roofs account for half the underground deaths of industrial America. An explosion at any instant may rob them of every breath of air and shatter their bones, so that they drop in their tracks like creatures in a slaughter pen. Sometimes they stumble into unseen pits and fall in blackness farther than if they had stumbled from the ledge of the Woolworth tower. But over all there is one dominating horror.

Miners call it "afterdamp." It is carbon monoxide, the same sort of deadly poison that issues from an automobile exhaust. Most modern mine rescue apparatus has been designed to make rescuers free to move in mine tunnels poisoned by afterdamp, as a submarine diver moves about on the floor of the ocean. A diver breathes air pumped from the surface through a hose; the mine rescuer carries with him a two-hour supply of breath.

The mine rescue crew prepares to go underground—a scene in one of Uncle Sam's new rescue cars, equipped with the last word in scientific apparatus.

Right: The crew setting out from the car. Note oxygen tanks and air filter bags on their backs.

Photos Courtesy U. S. Bureau of Mines

WITH the same furious speed that fire apparatus responds to a box alarm, mine rescue cars rush over railway lines in response to alarms of mine disasters. Within a surprisingly short time after the first word of the Mather mine explosion reached the surface, rescue cars rolling behind snorting engines arrived on the scene. Mather nestles on a Pennsylvania hillside. It is one of the cleanest mining towns in the United States. Normally about 750 men work there in eight-hour shifts. In the course of a year they bring to the surface nearly a million tons of high grade coking coal.

The night shift was just going into the workings in the huge elevator cage of the main shaft, and the day shift men were leaving, when the explosion came. Nick Shrake lived to tell how

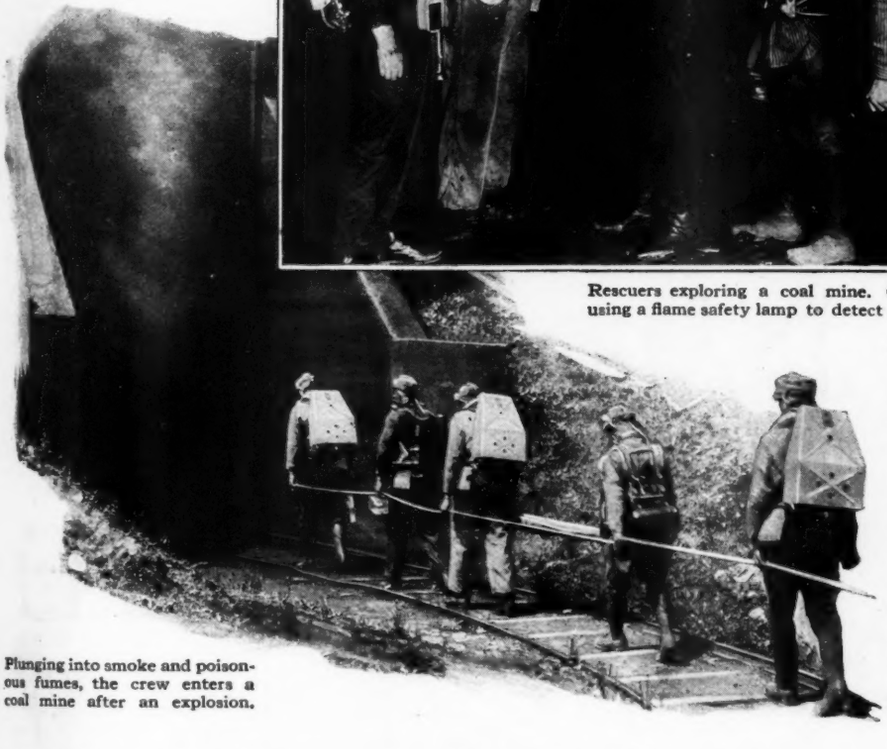
IN A glass case at the American Museum of Natural History lies the naturally mummified body of an Inca copper miner, entombed by a cave-in centuries ago. The figure testifies to the hazards miners always have faced. But it also is a reminder of the service of modern science in saving lives underground.

Mr. Sparkes tells here of this heroic rescue service, and of how the annual death rate in American mines has been reduced, from one in every 200 men employed, to three in a thousand.

it felt to him. There was a dinner bucket on his arm as Nick stepped from the cage into the wide corridor of the main entry, 350 feet below the surface. He had advanced only a few steps when he felt a rush of air against his face. A moment later a blast of air knocked him down, as it knocked down hundreds of others. Many of them never got up. A coal mine explosion drives through the black passageways with something like the force of a charge of powder in a cannon.

"AFTER I was knocked down," recalled Nick later, "I struggled to my feet. Then hot, black smoke bit my throat and lungs. I was dizzy, and wandered the wrong way—away from the shaft. At every step I stumbled over rocks, coal, and timbers hurled down from the roof. At last I realized I was going the wrong way. It was hard to breathe. I went back, falling at every other step. I heard men shouting and knew I must be near the air shaft that led to safety. Then the gas must have got me. I fell. The next thing I knew was when I came to, at the surface."

Rescuers exploring a coal mine. Center man is using a flame safety lamp to detect poisonous gas.



Plunging into smoke and poisonous fumes, the crew enters a coal mine after an explosion.

Meanwhile, word of the disaster had been flashed by telephone and telegraph to various mine rescue cars stationed in Pennsylvania. After a night of tragic vigil, frantic women and wide-eyed children saw a strange looking railway car shunted on a siding nearest the pit mouth of the Mather mine. Lettered on its side was this legend:

"United States Bureau of Mines
Rescue Car No. 3"

But the Bureau of Mines rescuers did not at once don their breathing apparatus, rush from the car, and plunge into the depths. Their first job was to consult mine officials, read maps, ask questions. How many men were entombed? Where? Was the mine on fire? They must be prepared for all emergencies.

Car Number 3 is one of the crack rescue cars of the Bureau of Mines. It was put into commission only recently. Already it has seen valiant service. Grim adventures are the common lot of men who bunk in this rolling laboratory.

Everything in that car represents the last word in scientific mine rescue apparatus. Beneath the car are stored stretchers, oxygen cylinders, coils of rope suitable for Alpine climbers, and sheets of canvas designed to serve as emergency walls or "brattices" in mine tunnels.

In the car itself are kitchen, dining room, an electrical refrigeration system, berths for the crew, a complete electric light generating system, a schoolroom where miners learn how to wear oxygen breathing apparatus; and in addition a curious store of apparatus designed to cope with flame, fume, and gas.

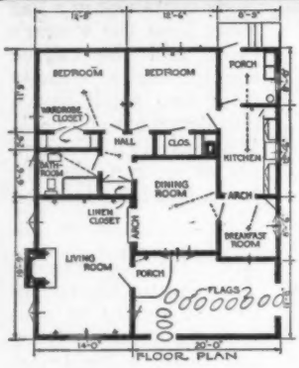
CANARIES sing in that surprising vehicle. They are the most elemental of mine life-saving appliances. Long ago men discovered that when canaries fall from their perches because of foul atmosphere it is time to find better air for human lungs. A rescuer who carries one of the birds into a mine knows that when the bird succumbs it is time to go—also that he still has time to go. Other equipment in the car includes a dozen sets of oxygen breathing apparatus, as many gas masks, two dozen carbon monoxide self-rescuers, two dozen electric flashlights, ten electric cap lamps, and chemical apparatus designed to warn of afterdamp by means of changing colors.

THE principal types of rescue apparatus necessarily include tanks of oxygen. The same air is breathed over and over, but each lungful passes through a filter of caustic soda contained in a bag slung from the wearer's back, and the oxygen supply comes steadily from two small tanks, also strapped to his back. If he has a two-hour supply of oxygen, then he has a two-hour lease on life.

IN THE Government apparatus the rate of oxygen supply is controlled automatically by the wearer's breathing. He breathes into and from a small bellows. When the bellows is sucked flat a valve opens allowing oxygen to feed in rapidly from the compression tank through a reducing valve. Thus, the supply adjusts itself to his needs during rest, when the consumption is only 300 or 400 cubic centimeters per minute, and during vigorous exertion, when it is between 2,000 and 3,000 cubic centimeters per minute.

Each wearing goggles to shield his eyes from smoke, a clip tightly closing his nostrils, and with the mouthpiece of his breathing apparatus held "air-tight" within his mouth, man after man of the mine rescue services of state and nation went down the deadly shaft of the Mather mine. These men found and sent to the surface the limp bodies of scores of miners. A few living men they carried out, but most of these were rescuers who had collapsed under strain. Nowhere in the mine was there breathable air. The only miners who escaped were men near the air shaft when the explosion came. Some of these had carried Nick Shrake to safety. A few had rushed down a stairway from one level of the mine to a level where they heard cries for help.

Ordinarily the doors of such stairways in mine workings are air-tight and carefully guarded. Mine workers, knowing their only hope is to keep themselves supplied with air, hold each passageway as a unit. Fans at the surface, when all is going well, keep air flowing into the deepest of the tunnels. The men who rushed down that crude stairway knew they were abandoning safety for peril. They went bravely into the blackness of the debris-strewn tunnel. Great chunks of fallen coal and heavy timbers pinned one worker to the tracks (*Continued on page 164*)

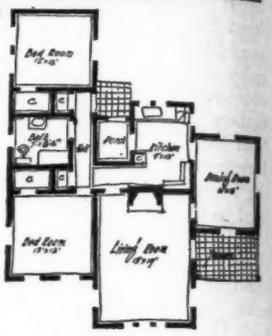


Here is a small Spanish house of simple, attractive design, built in Sacramento, Calif., at a cost of only $5,800. By ingenious arrangement of rooms, almost every foot of the floor space is utilized to advantage.

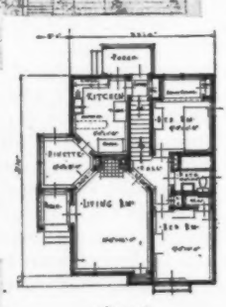
Improved Homes *at* Modest Cost

THE attractive dwellings pictured on this page are typical representatives of the latest advances in design and construction. Chosen from among hundreds of houses displayed in a recent nation-wide "Better Homes in America" competition, they offer convincing proof of the fact that attractive homes, embodying every modern comfort and convenience, can be brought within reach of families of modest means. All can be built at surprisingly moderate cost—the price depending somewhat, of course, on local conditions.

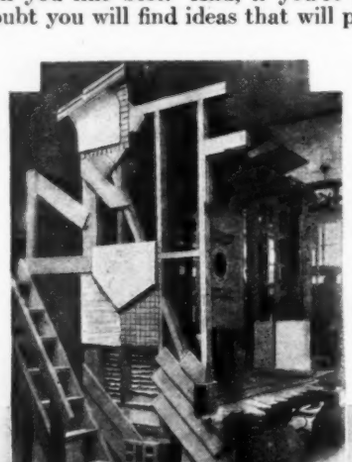
Radically different types of architecture are represented here. You'll find it interesting to study the plans and to decide which you like best. And, if you're planning to build, no doubt you will find ideas that will prove useful.



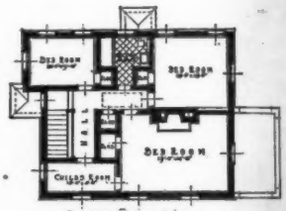
Another Spanish-type house, at Santa Barbara, Calif., a marvel of economy and beauty. This one cost only $4,165. Notice the arrangement of living, dining, and bedrooms to give plenty air and light.

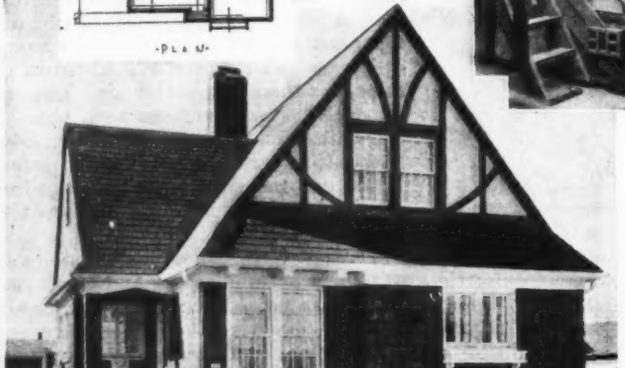


Left: High school girls' drawings of the house they designed shown below.



Left: An unusual exhibit in the "Better Homes in America" competition, showing various methods and materials of present day construction.





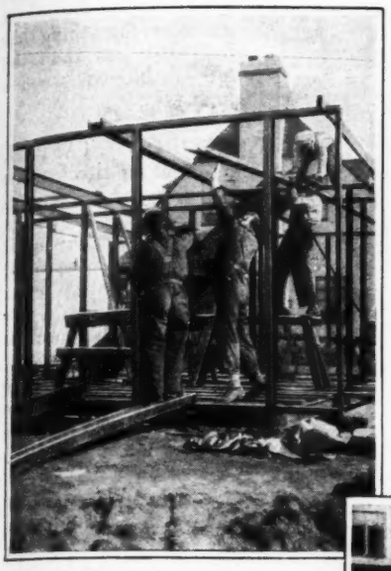
Girls of the Hutchinson High School, Buffalo, N. Y., planned this shingled house to show that unusual angles, if correctly handled, may add much to convenience in use. It cost $6,800 to construct.

A brick home at Greenville, S. C., ideal for space economy. First and second floor plans (above) reveal advantages of arrangement possible in a square house. Each bedroom has cross ventilation.

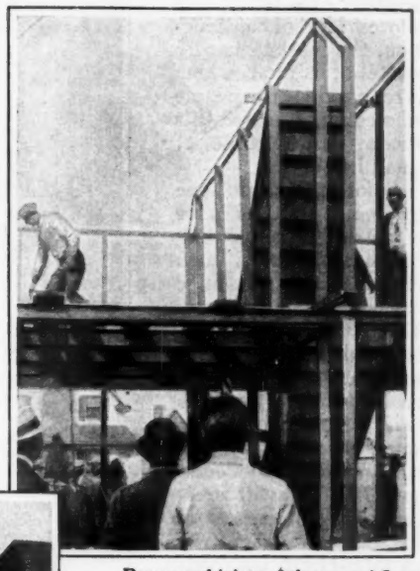
It's Here—the All-Steel House

Homes Already Reared in a Few Hours Point the Way to Wholesale Building by Assembly of Standard Parts—Mass Production Will Reduce Labor Costs

By
ARTHUR A. STUART



Erection of the steel framework of a house at Forest Hills, N. Y., in three hours and fifty minutes. The side framework being raised and bolted.



Beams and joists of the second floor are placed and firmly bolted and the steel stairway to the attic is erected. Side framework and roof are next.

Checking over the steel material which a few hours later was a house, built as illustrated in the photographs above. The material had all been cut by the factory to the required dimensions.

IN DETROIT, where automobiles are made and assembled with the speed and economy of a magic that is purely American, a steel house took shape recently with similar speed. One hundred minutes after a small crew of erectors appeared on that Detroit site the steel frame of the house was bolted into shape, its permanent stairways were in place, and all was in readiness for the next stage of construction—the placing of the floors and roof.

Through this demonstration and some fifty others in different places in the United States, the prospect for small house building, which has lagged far behind other industrial processes in America, has spurted forward amazingly. Each of these houses possesses in miniature the steel frame of a skyscraper; but they have, besides, a special significance and interest for the American family that can afford to spend around $5,000 for a home that will last a lifetime.

My interest in this development was first caught when in Forest Hills, Long Island, near my own home, there was a similar demonstration of rapid erection of steel framework for a small house. Three hours and fifty minutes by a stop watch after the hard-muscled crew of five steel workers had donned their overalls they stood on the staunch steel rooftree, finished, and a crowd of watchers cheered.

TIME had been the important element in the demonstration. The saving in time, and therefore of labor and other costs, is the thing that is expected to overbalance the greater cost of steel materials.

At Forest Hills and Detroit the erectors went at their work with a rush. The steel had been cut to size and shape and all bolt holes drilled. By means of spreaders and clip plates the parts were brought into line and held fast in a rigid frame.

The first step was the placing of the ground floor girders and beams; next the side framework was assembled and raised into position, then the partition frames and main stairway. Mounting that stairway, the workmen placed the second-story joists; then they raised the second-story bearing wall frames, bolted into position the stairs to the attic, and placed the attic floor beams, the roof trusses and, finally, the rooftree. The skeleton was finished. No derricks or hoists had been used, merely a rope tackle and from time to time a couple of wooden horses on which the workmen stood.

The completed Forest Hills house in which the higher expense of steel framework was offset by the saving of labor in the erection.

In these operations I see the beginning of an important movement in small house construction that has behind it all the weight of the economic pressure that is chiefly responsible for our present-day system of mass production.

America leads the world in low cost, mass manufacturing of many useful products. Practically everything we eat, wear, or use has become a factory-made thing. Because of this we Americans are the most prosperous and comfortable race on the face of the earth. By scientific drafting the perfection of machinery is made possible and by means of machinery we have achieved mass production.

IN THE last fifty years there has occurred a revolutionary change in the production of the necessaries of life. Even the poor among us have become accustomed to utensils of living that would not be within the reach of even moderately rich men except for this same principle of mass production. In only one field have we shamefully lagged behind its possibilities, and that is in the first essential of any civilization — the building of homes. We still build houses much as they were built in the middle ages.

Suppose that Henry Ford, or Nash, or Chrysler, or the General Motors people, built each car as a separate job. Suppose, after getting your order, they brought cumbersome machines, many mechanics and much more material than necessary around to your back yard and proceeded to make your automobile. Not more than one man in hundreds could afford even

the feeblest kind of automobile. Yet that is precisely the way we continue to build small houses, and that is why small houses are grotesquely expensive. The slowest kind of construction, the most laggardly wasteful, is that which is reserved for the people who can least afford this waste — the people of small incomes.

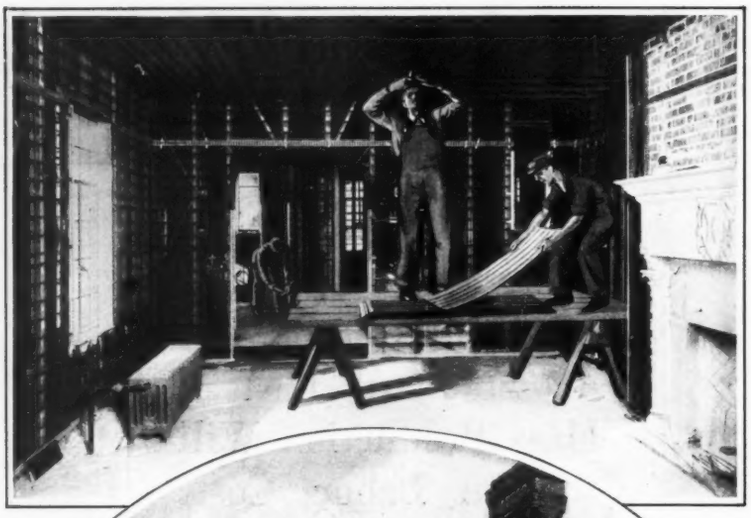
Before they can hope to change the character of small house building in America, steel men realize, they must change the methods of building. To that end their engineers, draughtsmen and architects are striving to evolve a plan for the swift erection of small houses, that may become an American phenomenon like the swift erection of skyscrapers.

AT THEIR last convention in Pinehurst, N. C., the American Institute of Steel Construction heard tempting things about this new market for steel. During 1928 about $2,000,000,000 will be spent on cheap houses of a type in which seventy-five percent of the material can be standardized; and another two billion will go into other simple types of wooden structures. They were told that if all of these buildings were to be provided with steel frames, the total steel business would be increased approximately $400,000,000. But this vision can be realized only if the steel manufacturers can offer frames on a competitive basis with wooden ones. This they hope to do by keeping their plants busy during what would normally be periods of depression, in making steel members for small houses to be stored like lumber until sold to small-house builders.

When mass production is discussed in connection with houses the objection is made that no one wants a house that resembles millions of others. But the argument is worthless, for basically a dwelling consists of rooms and their size and arrangement may be varied endlessly at the owner's wish without conflict with a scheme for mass production.

Standardization of plan is an important economical factor in production. This should be as true of houses as it is of automobiles, radios, vacuum cleaners, cameras, electric refrigerators, telephones and hundreds of other inexpensive conveniences. The easily standardized parts of a house represent probably seventy-five percent of the total cost. Individuality may be retained by complete freedom of treatment of inclosing walls, roof covering, color, location, the shape of entrances and porches, location and design of chimneys.

Everyone who might contemplate building a low price house is interested first of all in the cost. Such information as I have been able to obtain indicates that sixty percent of the cost of a $5,000 wooden house today is spent for labor and forty percent for materials. But there is hope that by changing the character of the materials, perhaps even spending more for them, labor costs may be reduced so as to make the completed house a stronger, finer thing that has cost less than the old fashioned wooden house.



The woodless house of a Gary, Indiana, steel man. Only brick, plaster, and other metal supplemented the framework and accessories, which were all of steel. Above: Putting in the steel ceiling of the living room.

ROBERT TAPPAN, the architect of the steel frame house in Forest Hills and the one in Detroit, told me that if the materials of a $5,000 wooden house cost $2,000, the materials for a steel-framed house like it would cost $2,300. "But," he added, "the labor on the steel house will be $2,500 or less as against $3,000 on the wooden house."

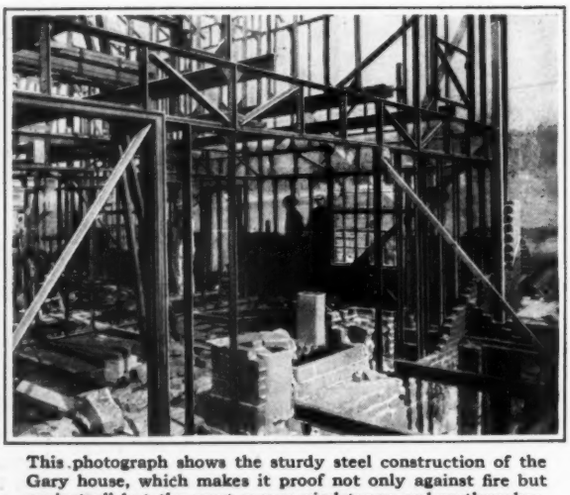
In Gary, Ind., where steel has raised a city out of the flat prairie within twenty-odd years, there are men who have a positive affection for steel that holds them as other men are held by a love of horses, politics, or fine books. Most of them spend their lives within sight of the cherry-red glow of blast furnaces. They work so close to steel in the making that the terrific heat often scorches their skins. In Gary, men are more constantly aware than most of us that this is the age of steel and that our civilization could not endure without it. So no one there was surprised a few months ago when the president of a steel company let it be known that he was going to build a house containing not so much as a stick of wood.

NATURALLY, for the president of a steel company the matter of expense is secondary. Nevertheless, even the erection of a mansion of steel may be expected to advance the cause of the small steel house. And the small steel house is a goal toward which steel men are striving just as did far-sighted automobile builders who saw a score of years ago that big fortunes awaited men who could produce cheap automobiles.

In this Gary steel house, advantage was taken of every existing steel appliance. After the frame had been raised, steel window sash began to arrive, followed by lath, radiator cabinets, doors, trim and bathroom cabinets. As the building took shape bricklayers veneered the hollow tile exterior and a brick chimney rose through the center of the house.

With the framework in place, steel fabric stretched across the tops of the floor joists and the

(*Continued on page 155*)



This photograph shows the sturdy steel construction of the Gary house, which makes it proof not only against fire but against all but the most severe windstorms and earthquakes.

Hot Water When You Want It

You Can Have It Always on Tap with Improved Automatic Heating Units That Save Countless Worries in the Home

By JOHN E. LODGE

"MARY! Why in blazes isn't there any hot water this morning? You might at least wait till I get through shaving before you draw it all off!"

"It's your own fault, John. You forgot to light the heater when you got up. Now you'll just have to wait."

Conversations like this, with variations, are common in thousands of homes. Most times they concern lack of hot water, but other unpleasant happenings also start heated arguments and take the joy out of life. Such, for instance, as having nothing but scalding steam come out of the hot water pipe, bathtubs filling with rusty water, faucets springing a leak, or bursting pipes flooding the place.

Yet none of these things need happen. With improved heating systems now available, hot water always is on tap, day or night; it is always clean, and hot enough without being too hot: faucets almost never leak and pipes never burst!

Many home owners do not realize how easily hot water troubles now can be banished. Of course, the solution depends on local conditions. In some places, gas, electricity, or both, are not available. It also depends, as far as expense is concerned, on the type of heating plant in your house.

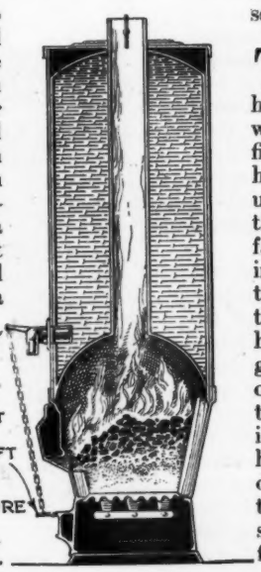
The ideal water heating system consists of a thermostatically controlled electric heating element and a heat-insulated storage tank. If the house is fitted with brass piping throughout, it meets every requirement. The water will always be hot enough without being too hot, and since the brass piping cannot corrode, the water always will be clean. However, in most localities this system has one great drawback—the cost of electric current is so high that only the very wealthy can afford it.

FORTUNATELY, where gas is available, you can have a system almost as good—the automatic gas water-heater. Its only disadvantages, compared with the electric system, are that it requires a flue to carry off the products of combustion, and that if the gas pressure is shut off for any reason, the burner must be relighted by hand. A typical automatically controlled gas water-heating unit is shown at the top of this page.

If your home is brass-piped throughout, it makes no difference how high you run the temperature of the hot water. The brass pipe will last almost forever. Water at temperatures much above 150 degrees, however, is very hard on iron piping. That is one reason why many homes have so much trouble with rusty water. Extremely hot water also disintegrates the cheaper types of faucet washers, causing trouble with leaky faucets.

One of the improved types of gas water-heating units, automatically controlled. It meets all home requirements.

Of course, it costs money to heat water all the year round with gas. The gas bills for the average small family will run from seven to fifteen dollars or more a month. The natural desire, therefore, is to obtain the heat from your furnace in winter. This can be accomplished satisfactorily only with a steam heating plant. In that case you can install a small round iron tank containing a coil of copper pipe, which is connected to the top and bottom of the hot water storage tank. Water from the steam boiler is piped to circulate in the small tank, surrounding the copper coil. Since water in a steam boiler always is at or near the boiling point, the water in the storage tank is heated by flowing through the coil, until it approaches the boiler temperature. It never can quite reach that temperature, however, due to radiation losses, so there is no danger of explosion. If your piping is brass, this method, in winter, in conjunction with an automatic gas water-heater in summer, represents maximum luxury at the lowest possible cost. Iron piping, however, is likely to deteriorate under the frequent high temperatures.



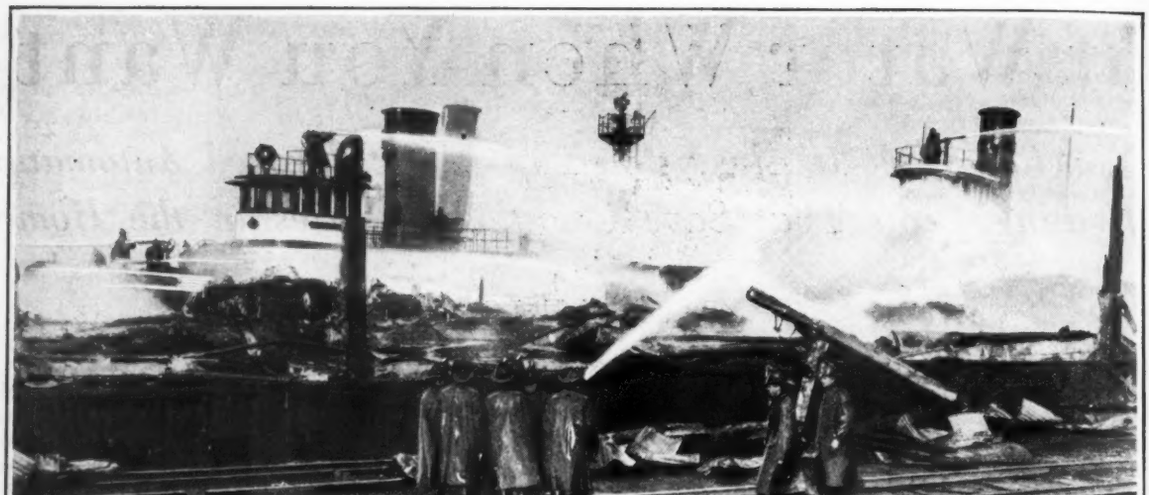
How coal heater is controlled by thermostat. It needs attention once a day.

THE water-jacketed coil cannot be used with a hot water heating system, because during mild weather the temperature in the boiler goes too low.

Where gas is not available, the best system is the thermostatically controlled coal-fired water heater. A sectional view of a unit of this type is shown at the bottom of this page. The thermostat opens and closes the draft so that the fire is automatically regulated. This heater will give as much hot water as the automatic gas heater at about half the cost, assuming average prices for coal and gas.

Other methods of heating water are in widespread use, but they have many disadvantages. There is, for instance, the hand controlled gas heater consisting of a coil of copper pipe over a gas burner. It will give plenty of hot water but turning it on and off is a nuisance, and if you should forget to turn it off, there is possibility of a serious explosion.

THESE simple and relatively unsatisfactory gas heaters often are installed with a pipe extending into the fire box of the furnace, to get hot water in winter without using the gas. Of all methods this one is the most unsatisfactory. If the pipe or cast-iron spider is placed too low in the fire box it interferes with the fire and supplies too much hot water. When a hot fire is going you may have to drain off the water every few hours to prevent an explosion. And if the pipe or spider is placed higher, you get no hot water during mild spells, and yet there still is danger of explosion when you speed up the fire during a cold snap.



Subduing a $2,000,000 fire on the Hudson River waterfront at Jersey City. Two fire boats, *New York* and *New Jersey*, are seen pouring streams on a blazing pier.

John Kenlon—Fire Fighter

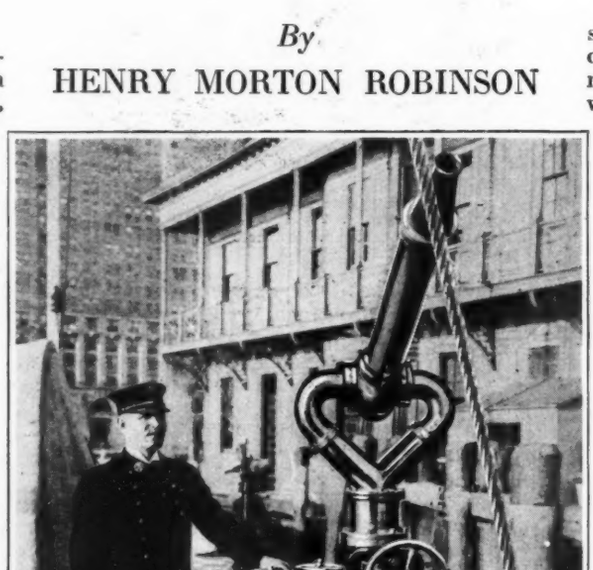
How Modern Science Tames Smoke and Flames Is Revealed in the Amazing Experiences of New York City's Fearless Chief

By
HENRY MORTON ROBINSON

MAROONED!

First Officer John Kenlon clung to a barren ledge of Hog Island, 1,800 miles west of the coast of Australia, and watched the last splintered planks of his vessel sink beneath the waves. Thirty-six hours ago he had been treading the bridge of a crack clipper ship bound from Liverpool to Melbourne. For the past day and night he had hung on to a bucking wheel while a savage hurricane had blown his ship 500 miles off her course, finally crashing her upon the cleaver rocks of Hog Island, an extinct volcano jutting out of the sea. The keel had been sheared off like cheese, and of the graceful hull not one whole plank remained. And now, the nineteen survivors of that crash were marooned in the loneliest part of the South Atlantic, castaways all, without food or shelter—300 miles off the nearest shipping lane!

As if this situation were not desperate enough, the captain now sickened and died. First Officer John Kenlon succeeded to the command—and a forlorn command it was, too. The men were utterly demoralized, starving, and shelterless. Straightway the new captain, scarcely more than a boy, began building up the morale of his crew. He organized hunting and fishing details, planned rude grass huts for shelter, and devised a huge fire beacon which was kept burning day and night. To keep his crew occupied while they waited for a passing sail he contrived to interest them in games and exploring expeditions. When one of the sailors broke an arm, it was Jack Kenlon who bound it in a rude splint of driftwood. As surgeon, captain, and his own chief-of-staff, the young leader kept a cheerful grin playing over his ruddy Irish countenance. But as he strode the bleak cliffs with his closest companion, Tom Fleming, he was despondent over the chances of getting his men off the desolate island.



Kenlon twenty years ago, as chief of the Marine Division of the New York Fire Department, on the deck of a fire boat.

"If only I could invent some kind of a craft," he kept saying to himself. "But what is there to invent with?"

Nothing! No tools, no timber—nothing but sand and rocks and sea!

"WELL," he said to the faithful Fleming, after two months of fruitless waiting and exploring, "about the only thing left is to lie down and dream out a way to escape the fix we're in."

"Dream?" queried Fleming in surprise. "You never struck me as being a dreamer, Captain. I've always thought your ideas ran to something more practical and concrete."

Concrete . . . a spark struck Jack Kenlon's inventive brain, setting it on fire with a daring idea.

"That's it, Tommy lad," he cried, scrambling to his feet. "*Concrete* . . . We'll build a concrete boat!"

"A concrete boat?" gasped Tom. "Why, Skipper, a concrete boat would sink."

"If an iron ship floats, why not a concrete ship? It's only a question of displacement. Anyway, it's worth trying. There's some limestone in these cliffs; we can crush and burn it for cement. As for sand and stone—there's no lack of either on this island, I'm thinking."

So Skipper Kenlon set his men to crushing rock, while he himself built a kiln in which to burn limestone for cement. He had built dozens of concrete houses with his father in his native Irish village, and had a thorough knowledge of the art. After three weeks of careful testing and mixing, he decided that he had the best concrete that could be made. At this point he turned his attention to the framework of the boat. With a few sticks of wood salvaged from the wreck of the clipper ship, he laid the skeleton of a boat thirty-two feet long and with a beam of eight and a half feet. To reinforce the slender strakes of his craft, ropes were laid along the core of the keel, with ribs of rope lying transversely across it to strengthen the sides of the boat. The actual pouring of the concrete was done in forty-eight hours. When the last scoopful had been poured, the weary company scarcely dared breathe the question uppermost in every mind:

Will she float?

THAT question was definitely answered when the concrete sloop made its trial trip around the island. With Kenlon at the tiller and Fleming in the bow as lookout, the boat attained a speed of ten knots, answered the helm beautifully, and shipped not a drop of water. The crew danced wildly on the beach as they watched the first vessel of its kind ever made by man skim the pounding breakers. They wanted to set sail at once for Australia, but the young captain would not be hurried into this long voyage without careful preparation. He made the crew salt down a month's supply of fish and rabbits, while he put the new boat through a series of gruelling trials. Triumphantly, she met them all! Finally, after a four months' sojourn on Hog Island, Captain Jack and his crew boarded their strange craft, and shoved off for the open sea.

In ten days they covered 1,600 miles without sighting a sail. Kenlon had no sextant or compass, but by dead reckoning laid a course for the west coast of Australia. When they were within 200 miles of their destination, with the concrete boat still staunch and seaworthy, they were picked up by a Melbourne merchantman. Their rescuers were unable to take the concrete sloop along, so it was regretfully abandoned.

THUS without loss of life or limb, Jack Kenlon brought his crew to safety in a homemade boat of sand and stone. Incidentally, the principle of its construction was so sound scientifically that the United States made hundreds of them during the World War.

As John Kenlon sits in Fire Headquarters in the New York Municipal Building, overlooking the city he has served for nearly half a century, he will tell you that he regards this and his other adventures on the high seas merely as preparatory to his life work as a fire fighter.

"The sea develops a man's combative spirit," he once told me, "and the science of fire-fighting utilizes every ounce of that spirit."

The same resourceful genius that led him to invent a concrete boat has asserted itself in a thousand ways during his upward career from a fourth grade fireman to the most famous of living fire chiefs.

The kernel of John Kenlon's attitude towards fire-fighting is this: *he regards every fire as a scientific problem, capable of the same deft and positive solution as a problem in laboratory physics!*

The Grand Street fire of May, 1924, described by Kenlon as the "most punishing" he ever fought. Choking clouds of smoke overcame fifty firemen before the chief arrived. He conquered the menace by breaking a skylight at the top of a stairway and forcing a smoke draft upward through the building.

THIS statement can be best demonstrated by a survey of half a dozen typical fires during the past thirty years in which Kenlon has played a major rôle. The first of these, and in some ways the ghastliest New York has ever seen, occurred on St. Patrick's Day in 1899, when the Windsor Hotel at the corner of Fifth Avenue and Forty-sixth Street was destroyed with a loss of fifty lives and $1,000,000. The Windsor, although it was the most fashionable residence hotel in the city, was a veritable tinder box—

Firemen rescuing guests trapped in the disastrous Windsor Hotel fire of 1899. It was the costly lack of water pressure during this blaze which led to Kenlon's winning fight for a city-wide high-pressure system.

"built to be burned," as Kenlon afterwards remarked. It had no fire escapes, no standpipes, no fire buckets. In short, it represented the worst type of the old-style "quick-burner."

At 3:30 P.M., just as the St. Patrick's Day parade was passing the hotel, a Windsor servant noticed that the lace window curtains on the second-floor parlor were ablaze. He started for an alarm box on Fifth Avenue but was blocked by the dense crowds watching the parade. Within five minutes red waves of flame were billowing from the second-story windows, and when the fire apparatus arrived, the Windsor was blazing like an oil-soaked pitch barrel. Panic-stricken guests hurled themselves out of windows or were incinerated in the drafty corridors. Milling thousands on the Avenue obstructed the firemen after their long run uptown (at that time the bulk of the apparatus was massed in the financial district, some five miles from the scene of the fire). And to cap a fearful climax, the water supply was found to be utterly inadequate!

KENLON, at that time a lieutenant with a record for conspicuous bravery, was ordered to throw a stream into a fifth-story window to protect a hook-and-ladder rescue party. He coupled his line to the hydrant, started water, and waited for the stream to materialize. But the portable steam pumps were taxed beyond their limit, and could only supply a pitiful sixteen pounds of pressure at the nozzle of Kenlon's line! "You couldn't even wash a window with that pressure," was his bitter comment as he saw his futile stream barely lift itself above the fourth story. In the fight against gravity, John Kenlon was temporarily beaten.

Six hours later the Windsor was a heap of smoldering ashes, concealing the charred bodies of half a hundred guests. But from that day forward, Kenlon dedicated himself to the task of converting New York City into a single great "high-pressure district." He realized that the rapidly changing architecture had rendered the old-style "steamer" as useless as the hand pumps which it had supplanted fifty years before. The passing of the wooden tenement and the advent of the modern, many-storied apartment house and skyscraper was gradually placing New York's fire apparatus on the junk heap! At a time when department politics made it dangerous for a young officer to speak his mind, Kenlon came out flatly for the high-pressure system, and was one of the most influential workers in the long campaign that saw the new system installed under Mayor McClellan in 1907. Thus, after ten years' struggle, Kenlon saw four thousand new hydrants in New York, with a maximum pressure of three hundred pounds at every plug!

To Chief Kenlon, the firemen directing this stream have a definite part to play in the solution of a scientific problem.

KENLON'S grasp of the scientific principles of fire-fighting was demonstrated at the official trials of the new high-pressure system. The tests took place along the North River front, and were witnessed by officials of city and state. Mayor McClellan, much impressed by the terrific force of the water, was curious to know exactly how far the high-pressure pumps could force an effective stream.

He turned to Kenlon, standing near by.

"Chief," he inquired, pointing to a twenty-story warehouse and office building, "can our new system throw a stream over that building?"

"Yes, Your Honor, it can," replied Kenlon without hesitation. "That building is only 350 feet high. With 200 pounds pressure on a two-inch line, the water will climb 150 feet over the building."

The water was started and mounted exactly 500 feet into the air!

KENLON had carefully inspected the new centrifugal pumps, located in four main pumping stations, and had worked out complete tables showing how high any given pressure would lift a known column of water. To him, Mayor McClellan's question was a simple problem in mathematics that he could apply with practical results to any building in the city. When Chief Kenlon orders a stream of water, he knows precisely where and how it will hit, and can prophesy with startling accuracy the effect it will have upon a conflagration.

"No two fires are alike, and no two fires will respond to the same treatment," is one of his favorite maxims. "Some fires need homeopathic, and some need allopathic measures. One fire has to be knocked out with a single blow; another has to be wearied into surrender."

As examples of this thesis, he recalls the Williamsburg Dock fire of 1911, and the Equitable building fire of 1912.

The Williamsburg Dock fire started with an explosion in a sulphur works. Directly across the street were oil yards of the Standard Oil Company, while fifty feet away were huge hay sheds, a thousand feet in length. When Kenlon arrived upon a third alarm, the sulphur works were

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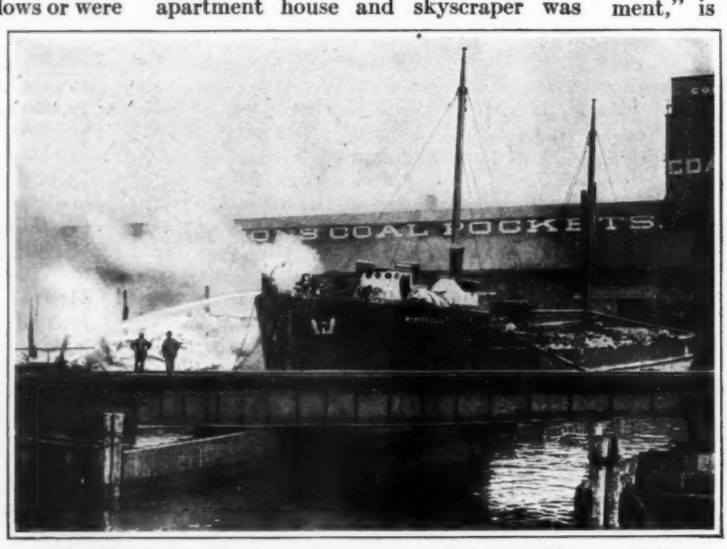


New York's 600 miles of waterfront present a fire hazard without parallel in any other city. Here is a view of a dangerous dock fire at Brooklyn, N. Y.

Millions *for* Mending Stockings

How Two Young Brothers Invented a Marvelous Machine Which Fixes the "Runs" in Women's Silk Hose

By EDWIN KETCHUM

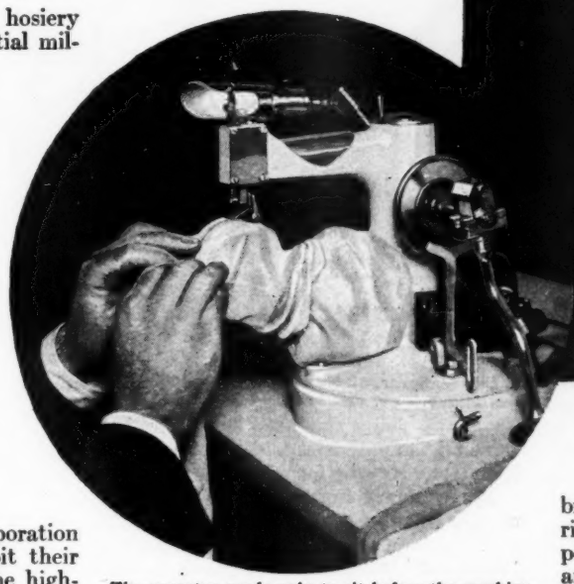
TWO young jobbers of hosiery have just become potential millionaires.

Within the last few weeks, they have seen their invention of an amazing stocking repair machine valued at $20,000,000. Perhaps, by the time you read this, thanks to their device, a disconsolate maiden with seemingly ruined stockings may walk to the nearest store and for a quarter or more, depending on the damage, have the pair returned to her as good as new.

That is the climax of the story of two young brothers—one twenty-five years old, the other thirty—who believe they have ended the bane of "runs" in silk stockings, after years of disheartening effort. The corporation they have just formed to exploit their remarkable invention includes the highest officials of a great New York hosiery concern. As rapidly as they can be built the machines are to be installed in retail stocking shops throughout the world.

Five years ago, Samuel B. and William H. Leavin were the proprietors of an obscure New York shop where they embroidered stockings for manufacturers. William had studied art for several years, and later had joined his younger brother in the business.

The inventors, Samuel (seated) and William Leavin, demonstrate how the machine automatically weaves a broken thread back into the fabric. It can make 300 repairs a day.



The operator needs only to sit before the machine and feed the stocking in until the "run" is mended.

ALWAYS interested in the mechanical side of their business, the brothers amused themselves by devising and trying out numerous improvements on machines in their shop. "In fact," William says, "we perfected one 'impossible' stitch that is still a mystery to the largest manufacturers."

Then came the idea of a run-mending machine. It was a logical consequence of their embroidering trade.

Stockings had to be run through the embroidering machines at high speed. Many a "second," or damaged silk stocking resulted when one of the machines failed of perfect adjustment, or when the hand of the girl operating it caught in the silk. "Seconds" cut deeply into profits; and the brothers decided to see if they could devise a machine to mend runs.

To build models of working parts for such a machine was costly. The brothers scraped together what money they could spare and went ahead. A part was built and tested, only to be discarded. Another succeeded, and was incorporated in the final design. At last, they arrived at a final plan which they believed would be commercially practicable if they could acquire capital to build and market the device. They went to officials of a New York hosiery concern with their drawings. So impressed were the latter that they supplied $60,000 with which to develop the device.

Now a complete model could be commenced. Almost at the start, the inventors encountered seemingly insuperable difficulties. To determine in advance the course of the broken thread, as the almost-human machine fed it back, in and out along the stocking's weave, appeared an almost hopeless task. So did the problem of controlling a needle that must fly back and forth rapidly enough to make three or four thousand stitches a minute! Not until about a year ago, when a crude model worked after a fashion, were the inventors encouraged to make a fresh start and attempt the final machine.

NOT long ago they stood again before the hosiery company officials, this time with the finished model. On its polished white base it resembled a sewing machine—but a sewing machine without a thread. Its cord was plugged into a wall socket, and one of the brothers placed a badly-run silk stocking on the feeder rack. A hum as the power was turned on, and—before the officials' eyes, the run disappeared! There was the stocking as whole as when new!

Actually the machine had sewn the broken thread responsible for the run right back into the fabric—a feat made possible by an odd-shaped needle with an eye at its tip that vibrated up and down almost faster than the eye could follow it, directing the thread up and down through the cross threads of the weave. So perfect was the control of this needle that with uncanny accuracy it always skipped over one cross thread and plunged under the next, re-creating the original weave. A pedal and a knee control were provided.

ALL that the operator had to do, the inventors explained, was to sit before the machine and feed the stocking into it until the mend was completed. It was entirely automatic. It could make 250 to 300 repairs a day.

The men who had advanced the money for development of the machine were enthusiastic, and for their company made the inventors a handsome offer—a million dollars apiece for all rights.

A staggering sum? Not to these young men—for they flatly refused it! Instead, they chose a share in the profits of their machine's operation. Their choice seems easier to understand when a person stops to think of the giant industry that is built around women's legs! Each year no less than a hundred million dozen pairs of stockings are sold. More than a third of them, or 35,000,000 dozen, are silk, fragile, and easily torn. If all the damaged stockings could be repaired, estimates place the saving to American women close to $80,000,000!

That is why the brothers who were once humble jobbers await the fortune that may be theirs when, soon, their machine is placed in service all over the world.

Solving the Mystery of Twins

New Tests Reveal Astonishing Facts about Secrets of Human Life and Problems of Environment and Heredity

By E. E. FREE

WHEN Nature sets out to produce a pair of twins one of her methods is the exact reverse of the marriage service. Instead of joining two to make one, Nature divides one to make two. The chief reason why many pairs of twins are so astonishingly alike that even their own mothers sometimes get them mixed is that they are not really two individuals at all, but are two halves of one individual, split apart early in the formation of their bodies.

Moe and Sidney Bauer, of New York City. Twins, so surprisingly alike, says science, are actually one person split in two.

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Measurements were made of other parts of the body and in almost every instance the right side of one twin turned out to be a virtual duplicate of the right side of the other one, like coins struck from the same die or slices cut from the same loaf of bread, each of which resembles all its sister coins or sister slices more perfectly than its own two sides resemble each other.

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During the earliest stages of this development by division the group of cells is a tiny oval particle somewhat the shape of an egg or a lemon. This tiny group of cells contains all the potencies and abilities of the body that is to be formed.

For ordinary human births the group of cells merely goes on with its growth and forms a human body. But when "identical" twins are to be formed, some accident or some natural process causes this small lump of living matter to split in two, as a lemon might be split along its axis of length. Both of the split halves grow independently and develop i to complete creatures. Since the corresponding sides of each are descended from precisely the same original living cells, both left sides are identical; both right sides are identical. But left and right of the same twin, being of different cell ancestry, may be unlike.

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Twins of the kind studied by Dr. Perkins are more likely, of course, to look exactly alike, and it is such pairs that are responsible for the mistakes and embarrassments which often make the lives of twins so interesting. Within the last few weeks two separate pairs of twins have even dislocated the machinery of American courts.

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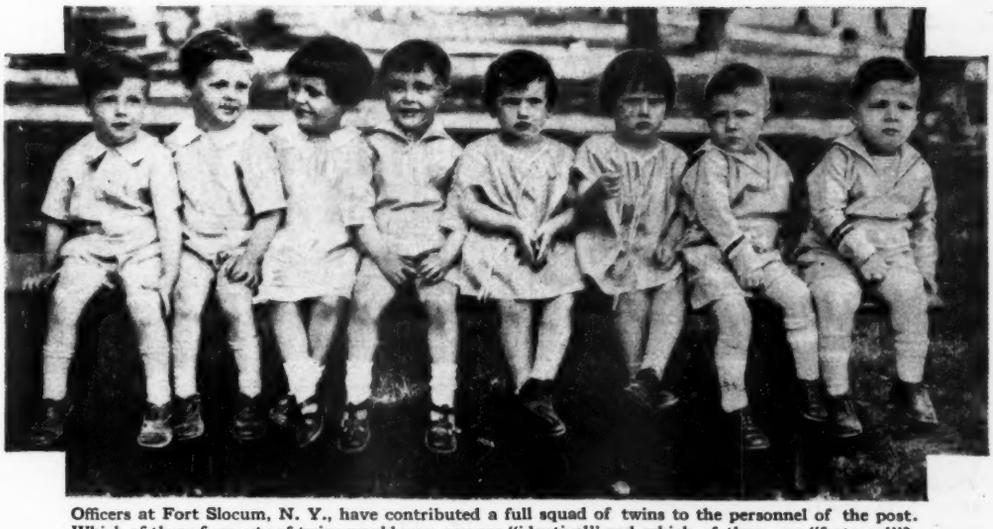

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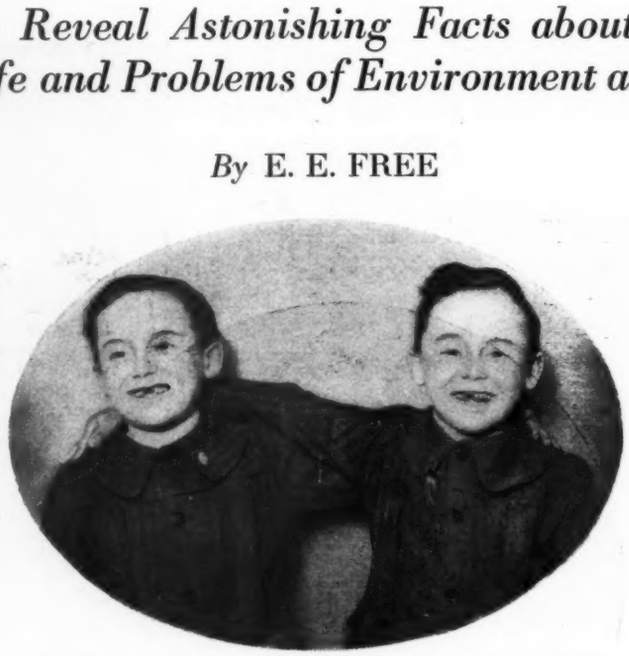

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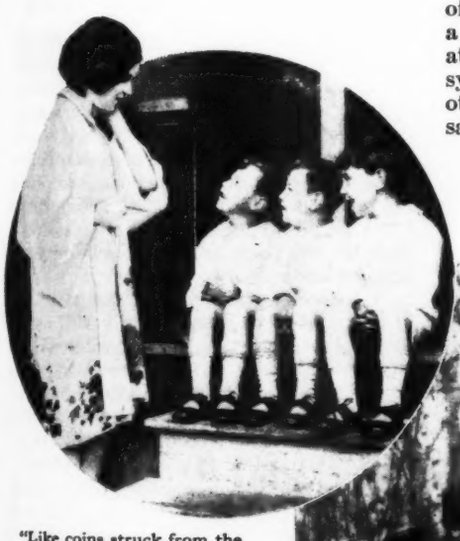

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Latest Ideas for Radio Beginners

Voltage Control Simplified

New Safeguards for Electric Sets—Testing Loudspeaker Quality—Uses for Old Parts—Hints for Drilling Panels

SEVERAL devices have appeared on the market that will prove useful if your electric receiver is located where the voltage of the light current is too high. One of them is shown in the illustration on this page. It is plugged into the electric light socket, and the plug from the electric set is screwed into the socket provided. A knurled rim can be turned to move a pointer that indicates figures on the barrel of the device. A concealed resistance is thus adjusted to cut down the effective line voltage.

Devices of this type, of course, are not automatic and consequently they will not take care of fluctuations in the line current. All that such a hand-adjusted device can do is to cut the average voltage down to a point where the high peaks still will be within safe limits.

Comparing Loudspeakers

HUMAN ears are such tricky pieces of mechanism that they can fool you into believing something that actually is not so. That is why it is so hard to judge loudspeakers. After hearing a loudspeaker in a friend's home, you may decide that it is not as good as yours when you turn on your own radio receiver a half hour later. Yet your friend's speaker actually may be much better. You probably have listened to your own speaker until your ear has become trained to overlook its deficiencies. Then, when you hear a superior speaker, your ear actually resents the presence in the music of tones and overtones that you ordinarily miss.

That is why it is almost impossible to compare two speakers unless you can hear them alternately working on the same receiver, with some arrangement that will permit you to shift instantly from one to the other and back again. By shifting back and forth quickly enough to catch part of the note on one speaker and the remainder of it on the other, you can get some idea of their comparative ability to reproduce high notes and low.

How Panels Are Ruined

THERE are two ways to ruin a radio panel during the drilling operations. One is to let the drill slip and scratch an ugly gash across the panel that will prove an eyesore all the time the set is in use, and the other is to drill the holes in the wrong places.

Of course the way to avoid scratching the panel is to take your time and be very careful. An extra half hour spent on the job certainly is worth while if it results in a perfect job.

Curiously enough, in most cases where the panel is ruined by misplaced holes, the fault is due to gross errors in measuring rather than to slight inaccuracies in marking the point where the hole is to be drilled.

For instance, you may have the panel on the bench ready to drill and your mind may be filled with a firm determination to make a perfect job. You are extra careful in the handling of the ruler and the rest of the tools so as not to mar the finish. With these precautions thoroughly in mind, you read a figure from the blueprint that calls for a hole three inches above the baseboard. You absent-mindedly place your ruler on the panel and with extreme care mark off three inches from the bottom of the panel, completely forgetting that the baseboard is a half inch thick, so that the actual measurement from the bottom of the panel should have been three and a half inches. Result: A ruined panel or a useless hole that spoils its appearance. Sometimes it is possible to hide a small hole by filling it with black sealing wax.

Uses for Old Radio Parts

THE fact that radio parts ordinarily do not wear out brings up the problem of what to do with old-style variable condensers, sockets, audio transformers, tuning coils, cumbersome old dials, and so on. If you have been a radio experimenter for some time your workbench undoubtedly is cluttered with parts that are just as good as they ever were. Yet you don't wish to put them in a new set for your own use.

However, if you will check up your list of acquaintances you probably will recall one or two older people in straitened circumstances who would appreciate a radio receiver of almost any kind. They, at least, will not be fussy about the fine points of modern radio apparatus. Get the old parts together and see if you can't, with the addition, perhaps, of a shiny new panel, put together a set that will give one of these friends a lot of pleasure.

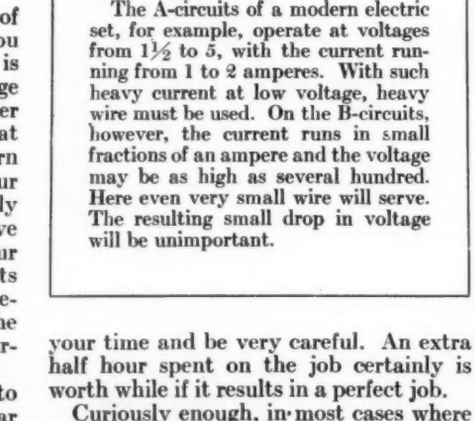
Solder with Rosin

RADIO receivers do not become less efficient as they grow old unless soldering paste has been used as a flux in making the soldered joints in the wiring. Such paste in time will creep over the insulated surfaces and cause an actual loss in signal strength. It is true that solder flows a bit easier with common soldering paste, but rosin core solder makes just as good a joint; and the rosin itself is a good insulator.

A B C's of Radio

THE resistance of any copper wire depends on its length and diameter. The shorter it is and the larger in diameter, the lower the resistance. Whenever you force electric current through the resistance of a wire you use up voltage or pressure. Thus, in figuring the wiring for any electrical circuit you must consider the amount of current you must force through the wire, and the voltage available to do the job.

The A-circuits of a modern electric set, for example, operate at voltages from 1½ to 5, with the current running from 1 to 2 amperes. With such heavy current at low voltage, heavy wire must be used. On the B-circuits, however, the current runs in small fractions of an ampere and the voltage may be as high as several hundred. Here even very small wire will serve. The resulting small drop in voltage will be unimportant.



One of the new resistance controls for cutting down line voltages that are too high. It plugs into the electric light socket, and in turn receives the plug from the electric radio outfit.

When power line voltages fluctuate seriously, the best thing to do is to call a service man to test the variations and adjust your receiver for the best average tone and volume.

How *to* Keep *Your* Electric Set *in* Working Order

By JOHN CARR

ELECTRIC radio receivers of the modern type cause less trouble than older battery operated sets. Occasionally, however, something does go wrong. Chances are that even if you are familiar with the battery operated receiver, you will hesitate to fix the electric set. Full electric operation somehow seems more mysterious. Actually it is not.

When a battery set goes dead, the trouble, in most cases, is failure of batteries. Power failure in an electric set means simply that the electric light current has been shut off.

The electric set, however, is subject to one trouble that never bothers a battery set. That is power line voltage fluctuation. The extent of this depends on the current requirements of your locality and the arrangement of the power lines. If, for instance, you are located at the end of a branch line some distance from the pole transformer, you are likely to notice a drop in voltage, causing lower volume in the evening when everybody turns on the lights. From ten to eleven o'clock the voltage will start to rise again as people go to bed.

If the fluctuations are severe, you are likely to have trouble with burned-out tubes. The first thing to do is to have a service man test the line voltage fluctuations over a period of twenty-four hours. He can then adjust your receiver for the best average results.

The only way you can make such a test yourself is with a high grade voltmeter of suitable range. Judging the voltage by the apparent heat of the tube filaments or the brightness of the dial light is inaccurate and useless.

Another possible trouble is a breakdown in the power unit, which stops reception. In every electric set is an alternating current transformer with a primary winding connected by a cord and plug to the house current supply. This transformer has several secondary windings. Usually there are two or more of low voltage to supply filament current to the various types of tubes in the set, and at least one winding that steps the current up to a voltage two or three times higher than that of the house current. A short circuit in the primary or low-voltage secondary windings is rare, so that if anything goes wrong with the transformer it is most likely to be a short circuit in the high-voltage winding.

When this happens the set stops operating, although the tubes still may glow dimly. There is a smell of burning insulation and wisps of smoke sometimes come out of the compartment containing the offending transformer. The only cure is a new transformer.

A TROUBLE with somewhat similar symptoms is a blown filter condenser. One of the sections in the group of high-voltage condensers may give way and become short-circuited. If the current is left turned on, the extra load on the transformer will rapidly heat it to the point where the characteristic smell of burnt insulation is produced. Here again, the only cure is the substitution of a whole new condenser block.

Actual breakdown of the mechanism of an electric set, however, is uncommon. Usually when trouble comes the tubes are to blame. Four types of tubes are in common use in electric sets. A rectifier tube in the power supply circuit rectifies the alternating current for the B-circuits. As this tube nears the end of its life it passes less and less current. The B-voltages consequently drop with corresponding loss in volume. Just before the tube goes dead it may cause peculiar gargling and quavering noises.

IN THE radio-frequency and first audio amplifier stages the low-voltage A. C. tube is used. If one of these tubes goes bad in a radio-frequency stage, the result will be a loss of signal strength. Tone quality will not be affected. If the tube in the first audio stage gives out, the set will seem to be as sensitive as ever, but the tone will become thin and scratchy with considerable distortion.

The heater-type tube operating on two and one fourth to two and one half volts of alternating current is universally used in the detector stage. It is this tube which is responsible for the time which elapses between the turning on of the current and the reception of signals. This time interval may vary from fifteen to forty-five seconds or more. The signals always come in more quickly with a new tube than they do with an old one, and this fact can be used as a rough indication of the condition of the tube.

A common battery type 171A power tube, or two of them, in a push pull circuit is the regular last stage of audio amplification.

A Modern Set in Easy Steps

You Begin Here by Building a One-Tube Outfit, and Add to It Later, Until You Have a Full Electric Receiver

By ALFRED P. LANE

HERE is the first of a series of radio constructional articles that will appeal particularly to beginners. Each one will describe a complete receiver, starting with the inexpensive, modern one-tube receiver detailed on these pages. The next and succeeding articles each will detail the same receiver with additional parts to make it more powerful, so that the last article will describe a full electric set that will give good results on distant stations, show a satisfactory degree of selectivity, and operate a loudspeaker with good tone and volume.

As you will note from the front view of the panel, the receiver, even in the one-tube stage, looks complete, and the panel appearance will not change materially as the additional apparatus is added. The baseboard, which shows clearly in Fig. 3, seems somewhat unoccupied. Succeeding articles will show how this space is utilized in enlarging the set.

Because the short waves are becoming more important, the receiver is tuned with standard plug-in coils so that you can receive all waves from fifteen meters up to the highest in the broadcast band.

WHILE the beginner will be wise to follow the exact construction shown, you can, of course, eliminate the plug-in coils and substitute a fixed hand-wound coil if you do not want to receive the short waves. POPULAR SCIENCE MONTHLY Blueprint No. 97, now available, gives details on this point as well as the regular construction and wiring. A complete list of the parts actually used in constructing the receiver also is available, but in order to make the construction as economical as possible the design has been worked out so that there is considerable latitude for the selection of different makes of parts.

Since the complete receiver will be of the simplest possible full electric type, a novel arrangement is presented in this article for the operation of one tube. A single heater-type 227 tube is used, and as the picture wiring diagram of Fig. 3 shows, a filament heating transformer supplies the A-current to this tube. This filament heating transformer can be obtained at less cost than any standard storage battery, and the same transformer will be used to operate all the tubes to be added later. By this arrangement you get rid of the A storage battery and the necessity of charging it, or the use of a less efficient dry cell type tube that would have to be discarded later on anyhow.

For B-current, a standard 45-volt dry cell unit is employed. Such a battery will give good service on a one-tube set of this type for over a year. Ultimately a special B eliminator will be described that will supply the B and C voltages and so make the completed receiver full electric.

In localities where no 110-volt alternating current is available, the constructor must use either a dry cell type tube such as the 199, or the ordinary storage battery tube such as the 201A. Blueprint No. 97 includes a picture diagram covering the changes needed if battery operation is necessary.

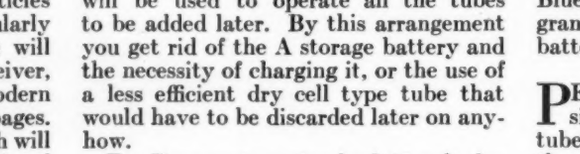
PERHAPS you will recognize the similarity of the circuit to the one-tube short wave adaptor units shown in the August, 1928, issue of POPULAR SCIENCE MONTHLY. The only essential difference is in the control of regeneration. Instead of using a variable condenser, the new circuit makes use of a variable high resistance. Either method of control gives good results, but the resistance method is a little easier to operate, as there is not the tendency to "plop" into oscillation as sometimes is the case with the condenser.

You will need these parts to build this modern one-tube receiver:

A1, B1, C1—short wave coil set, including mounting and extra coils to cover the broadcast band of wave lengths.
D1—variable condenser, .00014 mfd. capacity.
D2—grid condenser, .0001 mfd. capacity with clips.
D3—fixed condenser, .0005 mfd. capacity.
E1—radio-frequency choke coil, 85 millihenries inductance.
F1—grid leak, 5 megohms.
F2—variable resistance, 0 to 5,000,000 ohms.
G1—socket for heater type 227 vacuum tube.
Drum dial, panel 7 by 21 inches, baseboard ½ by 10 by 20 inches. Wire, screws, etc.

THE tuning unit in the model receiver has a base which is mounted in the location shown in Fig. 2. Changing the wave length range of the receiver is merely a matter of plugging a different coil unit into this base.

None of the other parts require special mention except, perhaps, the variable resistance F2 and the drum dial. The variable resistance is of the graphite compression type. Other types could be used, of course, but they might require a different value of fixed condenser at D3. Almost any type of drum dial can be used, if it will fit into the space provided and can be connected to the condenser where shown. In the model receiver, the variable condenser D1 has a detachable shaft which can be pulled



The attractive front panel, up-to-date in every way.

POPULAR SCIENCE MONTHLY Blueprint No. 97, describing in still greater detail the construction of this modern one-tube radio receiver, is now available. It can be obtained for 25 cents (see page 100).

A complete list of the parts approved by the Popular Science Institute of Standards for use in constructing this one-tube receiver will be mailed with each blueprint, or will be mailed without charge to readers who do not desire the blueprint. Address requests for advice or information to: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

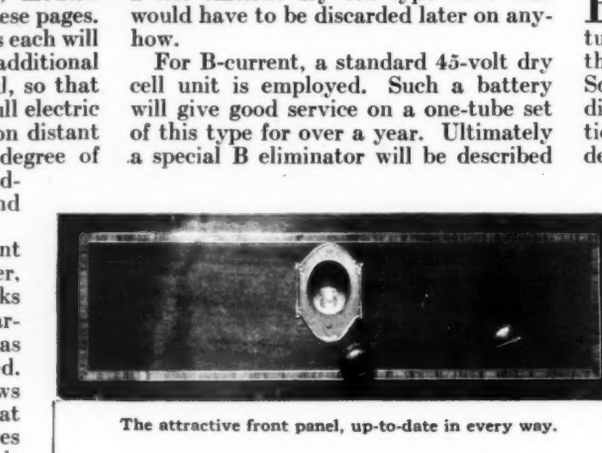


Fig. 1.—How instruments of the one-tube set are placed on panel and base. The dial light is wired to F and F terminals of the socket.

out far enough to project through the drum dial and out the other side. This construction simplifies mounting and will make it easy to add another condenser later on the other side of the drum.

The size of the panel can be increased to 7 by 24 inches and the baseboard to 10 by 23 inches if you want still more room around the instruments to do the wiring. Do not attempt to use a smaller panel or baseboard than specified if you plan to enlarge the receiver. Of course, if you wish to make this a permanent one-tube outfit, you can use as small a panel as will allow the parts to be mounted.

A STUMBLING block for most beginners is to obtain a baseboard that is not warped. The baseboard of the model receiver was made of several layers of thin plywood like that used on the sides and ends of many types of packing cases. After a sufficient number of layers of this thin wood had been cut to the proper size, they were placed on top of one another and rows of small wire nails were driven through and clinched on the other side. This makes a strong construction that is not likely to warp, and the material usually can be had for the asking.

The panel also is held to the baseboard by a novel method. Instead of using ordinary wood screws driven into the edge of the base, No. 6-32 brass flat head machine screws were used and holes were drilled into the edge of the base with a No. 27 drill. Then ⅜-inch holes were drilled down through the base across the ends of the small holes. The machine screws were pushed into the small holes through the panel and the base so that the ends protruded into the vertical ⅜-inch holes, where brass nuts were threaded on them and the screws pulled up tight. This method would not be necessary on a solid baseboard, but ordinary wood screws would be likely to pull out of holes drilled into the edge of several thin boards that are simply nailed together. The ⅜-inch holes are visible in Fig. 2.

IN MOUNTING the drum dial follow the instructions of the manufacturer as accurately as you can. Mount all the rest of the parts according to Fig. 3. Extreme accuracy is not necessary in the placement of the parts. Follow the layout as nearly as you can by eye measurement. Make sure, however, that the base of the tuning unit A1, B1, C1 is exactly at right angles to the front panel.

The wiring should present no difficulties. Simply follow the pictorial wiring diagram shown in Fig. 3, or the technical diagram in Fig. 4. Note that the rotary plates of condenser D1 (the frame connection) are connected to the K binding post of socket G and one terminal of resistance F2.

The coil mounting has two binding posts connected by flexible wires to coil A1, which is attached to the mounting by a hinge. The antenna and ground leads are clamped under these binding posts as indicated. The four sockets for the four plugs on the detachable B1, C1 unit are marked F, P, B and G, reading from the antenna and ground binding posts.

The two binding posts for the headphone cord tips are for use while the outfit is used as a one-tube set and will be removed when other parts are added to enlarge the receiver. You can, therefore, leave them out entirely, in which case one of the phone tips is fastened directly to the terminal of the radio-frequency choke coil E1, and the other is attached to the plus terminal of the B-battery.

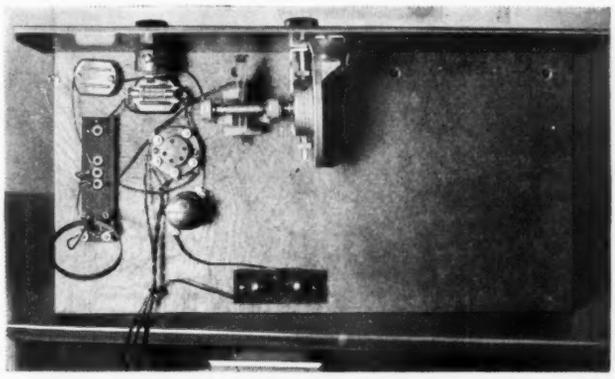


Fig. 2.—Follow this arrangement in laying out the instruments on the baseboard. Be sure that the tuning coil mounting, shown at the extreme left, is put in a position exactly at right angles to the panel.

After you have the receiver completely wired and you have carefully rechecked your wiring, connect the twisted cord from terminals F and F of socket G to the 2½-volt terminals of the A-power transformer. Then connect on the B-battery, the antenna, the ground and the headphones as shown in Fig. 4. The antenna should be a single wire about one hundred feet long and as high as possible.

Screw the knob of the variable resistance F2 out as far as it will go, put on the headphones, insert a UY 227 tube in socket G1, and plug the cord from the A-power transformer into the nearest electric light socket. Nothing will happen for from 15 to 45 seconds, and then you will notice that the center electrode in the tube has become a dull red. Wait until you notice no more change in the color of the electrode and then slowly screw the knob of F2 toward the panel. Considerably before the knob reaches the limit of movement you will notice first a slight hissing and then a faint click. Now turn the dial until a whistle is heard. Stop at that point and immediately turn the knob of F2 out until the whistle disappears and the broadcasting will be heard with reasonable volume if it is a local station.

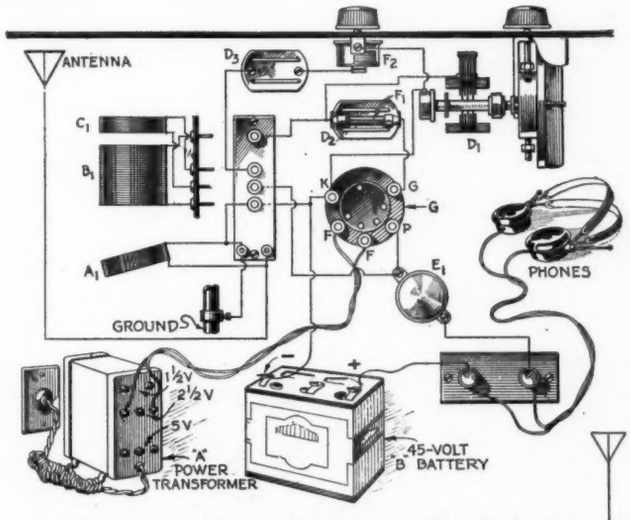


Fig. 3.—Pictorial diagram for the beginner, showing layout of parts and complete wiring of the one-tube receiver, including connections for power supply, headphones, and coils.

NEVER operate the receiver with the knob of F2 screwed in so far that a whistle, changing in pitch, can be heard when you tune the dial back and forth across the wave of any station. If you do you are likely to interfere with your neighbors' reception. If you keep the knob always out far enough so that no squeal can be produced, you will cause no interference.

You may find that the whistle cannot be produced at certain points on the dial. That difficulty can be remedied by turning coil A1 farther away from coil B2. You are most likely to notice this dead spot effect on the shorter waves. Broadcasting on the shorter waves is received in the same way as on the regular broadcast band with the set in a non-oscillating condition. Short wave amateur code work always is received with the knob of F2 turned in just beyond the point where the click is heard and where the dots and dashes are heard in a chirpy tone that warbles like a canary with the asthma.

DO NOT expect too much from a one-tube set. It cannot equal a larger set for distance, selectivity, or volume. Expect those desirable features only after you have added tubes to the set according to instructions that will appear in future articles.

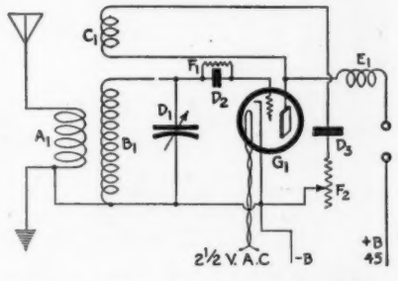


Fig. 4.—Technical wiring diagram. Regeneration is controlled by a variable high resistance.

Distant stations may be heard with the one-tube set at times when conditions are just right on the broadcast band of wave lengths. Of course, a high and long antenna is needed for best results in distance. On the short waves you may hear amateur stations operating in all parts of the world if you are in a good location.

Strange Colors We Can't See

Surprising Tests Explain Why Some Folks, Like Bees, Are Blind to Red and Green — How Our Eyes Catch Rainbow Hues

By P. A. CARMICHAEL

THIS would be a dreary world if everything in it were either white or black, and man never saw any color but those. To look at a deep red rose and see only a cluster of blackness; to find the leaves of a tree all a dull white; to see a clear sky as a dome of granite gray; to get from the sight of leaping flames only the impression of fog—all this could happen only in a strange, fantastic world.

But that depends on whose world it is. There are people and creatures who have not the powers of sight which a normal human being has; for example, persons totally color blind—and, oddly enough, cats. They see the same things that we see, but theirs is a world of black and white.

Then there are others whose sight, while not confined to black and white, still misses many of the colors we see. A bee is such a creature, and so are most fishes. They see only blue and yellow. All else is black or white, or some shade partly black and partly white.

A noted scientist, Prof. K. von Frisch, of Munich, Germany, experimented on bees to discover what colors they see. In an aviary he coated certain blue objects with a sweet substance. Other objects of thirty-two different shades of gray he left uncoated. The sweet coating quickly drew the bees to the blue objects; the gray objects they left untouched. In a few days the bees had learned to look for food on all blue objects and not on gray objects. Accordingly, when he placed in the aviary new objects colored blue and gray, but without any sweet coating on either, the bees immediately flocked to the blue as before, and again passed the gray by. Clearly it was the blue color that drew them, not the coating.

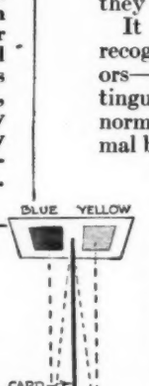
Using yellow objects in similar experiments, Professor von Frisch then educated the bees to look for food wherever they saw yellow. Next he tried red and black. Try as he would, however, he could not induce the bees to distinguish between those two colors. Next he tried them on green. This, likewise, they failed to distinguish.

It was clear, then, that the bees recognized only two fundamental colors—blue and yellow. They could distinguish only half of the colors that the normal man can distinguish (the normal being blue, yellow, red, and green, with their combinations).

Oddly enough, the two colors which the bee sees are just the ones to which, as a rule, partly color-blind persons are limited. They cannot tell brown from red or green in daylight, nor red and green from each other. This is a handicap, especially in driving an automobile, because of the red and green traffic lights. I know one such color-blind person, however, who learned a trick that saves him trouble. He observed that the traffic lights were so arranged that the green, or "Go" light was on top, the amber or "Caution" one in the middle, and the red or "Stop" at the bottom. Though all looked alike to him, he learned to identify them by their positions.

However, traffic lights nowadays usually are not pure red and pure green. In the red ones there is a tinge of orange, and in the green a bit of blue, making them distinguishable to many partly color-blind persons.

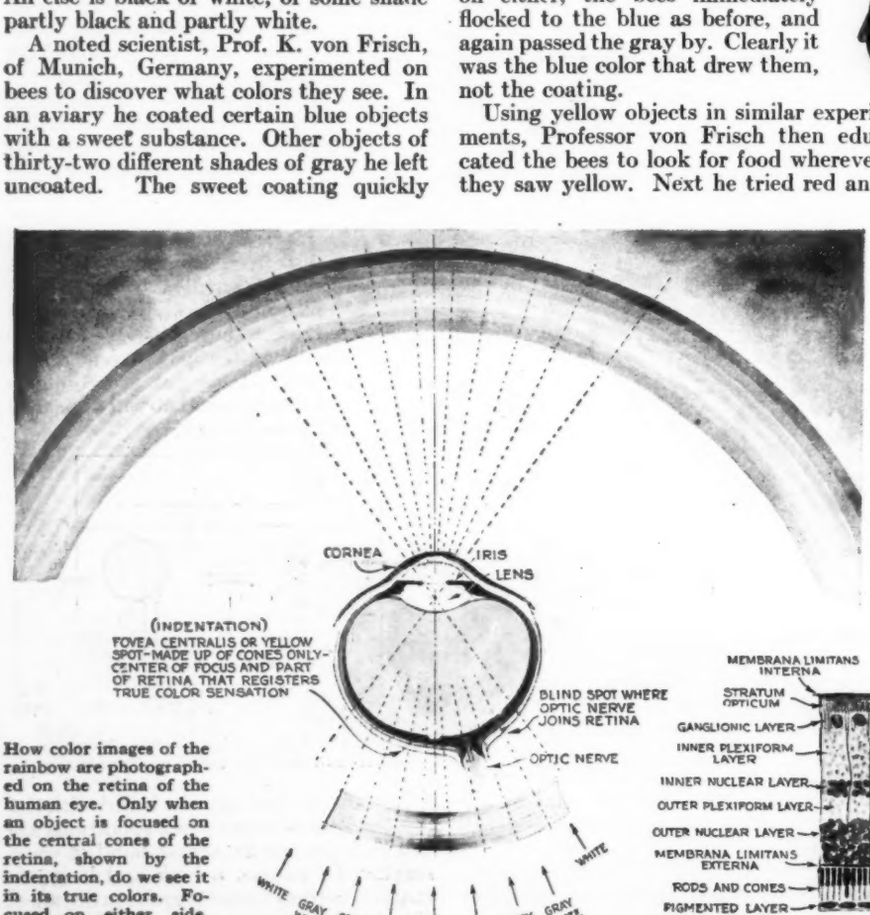
TRY this test: Holding a card edgewise between your eyes as a screen, as shown in the diagram, try to see blue with one eye and yellow with the other at the same time. You'll find that you see the two colors as one—a kind of white. This test, say experts, supports the theory that ancestors of man saw only white and that our color perceptions are a result of evolution.



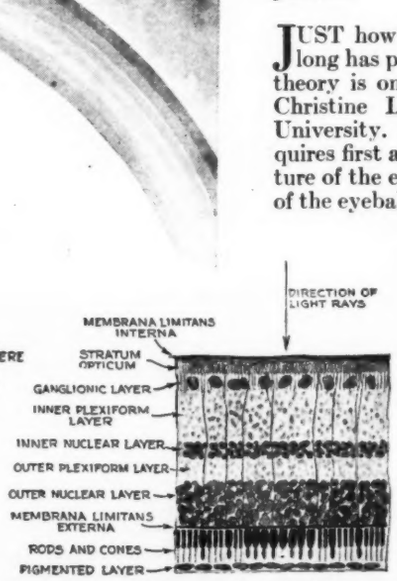
JUST how the eye distinguishes colors long has puzzled scientists. The newest theory is one recently advanced by Dr. Christine Ladd-Franklin, of Columbia University. To comprehend it clearly requires first an understanding of the structure of the eye. The back part, or retina, of the eyeball is like the inside of a saucer. On it are cast the images of everything that we see, just as images are cast on a photographic plate—the eye itself being simply a highly developed camera. The retina is made up of a vast number of little instruments, called "rods" and "cones" because of their shape. The cones are concentrated at the center, gradually thinning out and giving way to the rods at the rim.

It is near the center of the retina, in the spot

(*Continued on page 150*)



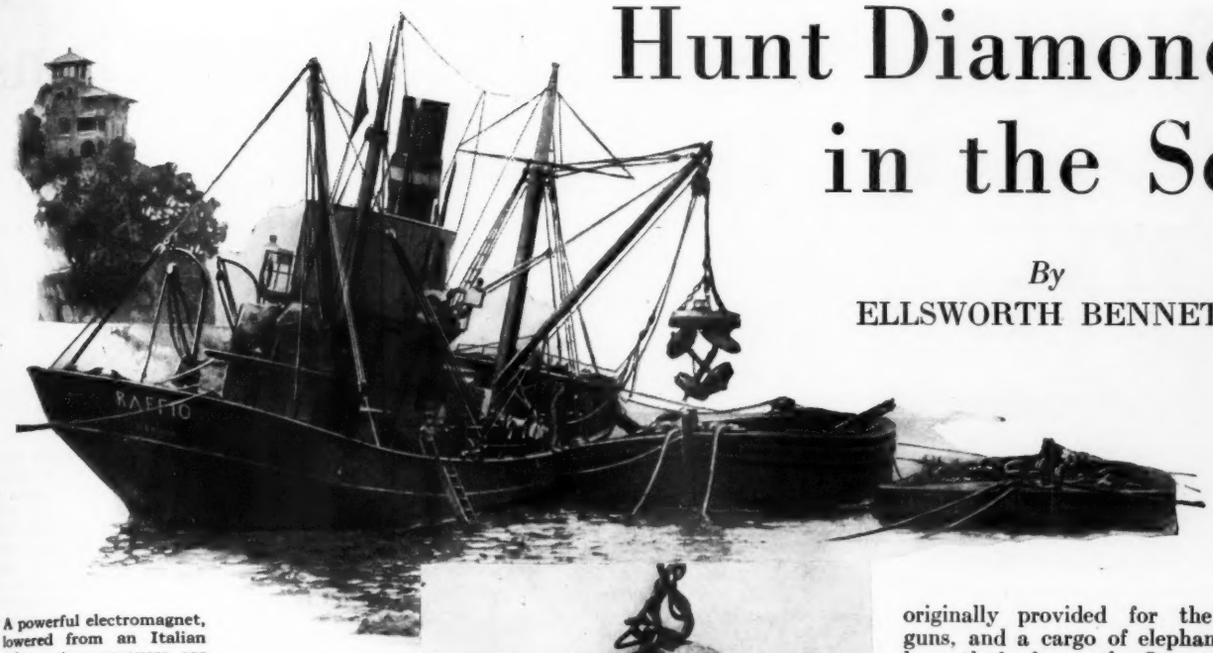
How color images of the rainbow are photographed on the retina of the human eye. Only when an object is focused on the central cones of the retina, shown by the indentation, do we see it in its true colors. Focused on either side, where the rods are, it appears grayish or even white. Left eye is shown.



The intricate structure of the retina, showing arrangement of rods and cones, the instruments which give us color sensations.

Hunt Diamonds in the Sea

By ELLSWORTH BENNETT



A powerful electromagnet, lowered from an Italian salvage tug, recovers car wheels located by divers using the new equipment.

ONE of the oddest of treasure hunts ended at Saint Nazaire Harbor, France, the other day, after a successful test of new deep-sea diving apparatus of German design. It had recovered 2,000 francs in Belgian currency notes, a few coins, and a packet of papers from the captain's safe in the derelict Belgian steamship *Elizabethville*, sunk in two hundred and forty feet of water off Belle Isle, situated south of Brest on the French coast, in 1917.

Though 13,000 carats of diamonds believed to be aboard the sunken ship were nowhere to be found, a valuable cargo of ivory was disclosed that may yet be salvaged. More important still, the first practical test of the deep-sea diving equipment forecast possible future recovery of some part of the quarter-billion dollars' worth of gold and gems, besides ancient art relics, scientific records, and zoological specimens of untold value, known to be in wrecks that have sunk to the bottom of the sea.

Hitherto terrific water pressure at great depths has barred attempts of divers to reach these wrecks, since it would crush a man in a rubber diving suit. The all-metal diving armor was chosen by an Italian salvage concern that organized the latest treasure search. In this outfit cast steel cylinders form the body of the suit, with jointed iron legs and "mechanical arms" with steel hooks for hands. Oxygen flasks within dispense with the usual diver's air line, though a telephone line keeps him in communication with his ship. In the air, the ponderous suit weighs 800 pounds; in the water, only forty. With such an outfit, it is reported, a diver can descend rapidly to great depths with no discomfort.

WHEN the apparatus was first tried out during salvaging operations on a sunken wreck in Italian waters, divers using it recovered valuable railway material. Heavy car wheels and similar objects were hoisted to the surface by large electromagnets lowered into the water from the salvage tug *Raffio*. Immediately it was decided to search for 13,000 carats of diamonds and quantities of other gems reputed to have been in the captain's custody aboard the Belgian steamer *Elizabethville*, sunk by a German submarine during the World War.

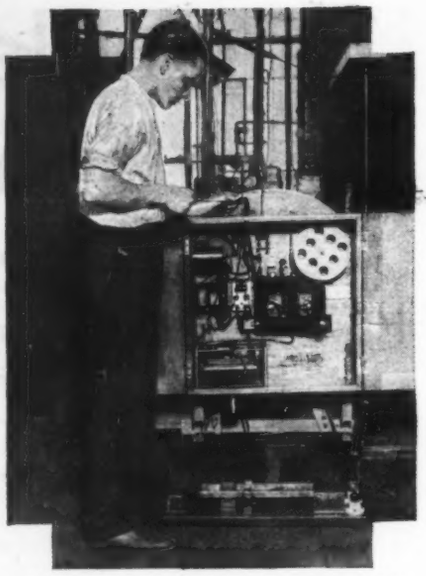
A diver in the new deep-sea armor, being hauled from the water after a search for treasure forty fathoms under the sea. Right: The rusted steel safe recovered from the wreck of the steamer *Elizabethville*.

Forty fathoms deep lay the *Elizabethville*, broken in two on a flat submerged rock. Fish were swimming through the engine room. To get into the strong room, where the diamond treasure was supposed to be, divers placed dynamite charges that blew a hole in the deck.

Instead of diamonds, when they entered the hole, they found stacks of shells originally provided for the ship's guns, and a cargo of elephant tusks beneath the forecastle. One promising object proved to be a gold-plated safety razor, which a diver picked up with his mechanical hand and carried to the surface. Up forward in the captain's cabin, however, a rusty steel safe came to light. The roof above it was blown off with dynamite and the safe was hoisted aboard the salvage ship with a derrick and powerful magnets. When it was broken open, no diamonds could be found, indicating that if the vessel still contained treasure it lay beyond hope of salvage. Tons of material had been brought to the surface, and the diving equipment had functioned perfectly at twice the depth long considered the limit for safe diving operations.

The diving armor, it is announced, will be used to salvage treasures from other wrecks sunk in the sea.

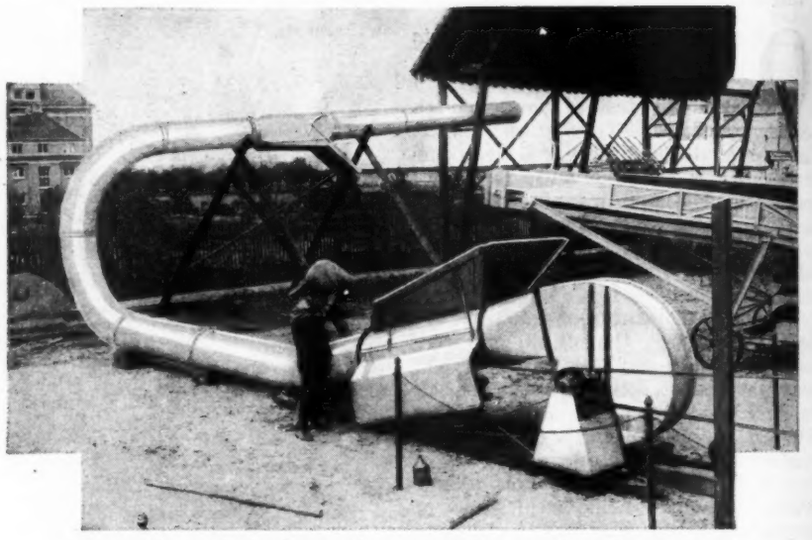
Useful New Creations Of Inventive Minds



The "pick-up" of automobile motors with various fuels and carburetors is tested with this new device by the U. S. Bureau of Standards. A motor runs a strip of paper between two electrodes which produce electric sparks at regular intervals. The closer the holes made by the sparks, the faster the motor.

With this new oxygen helmet, demonstrated by a Los Angeles fireman, one can spend many minutes under water or in stifling smoke. A clip closes the nostrils and oxygen from a tank carried on the back is breathed through mouthpiece.

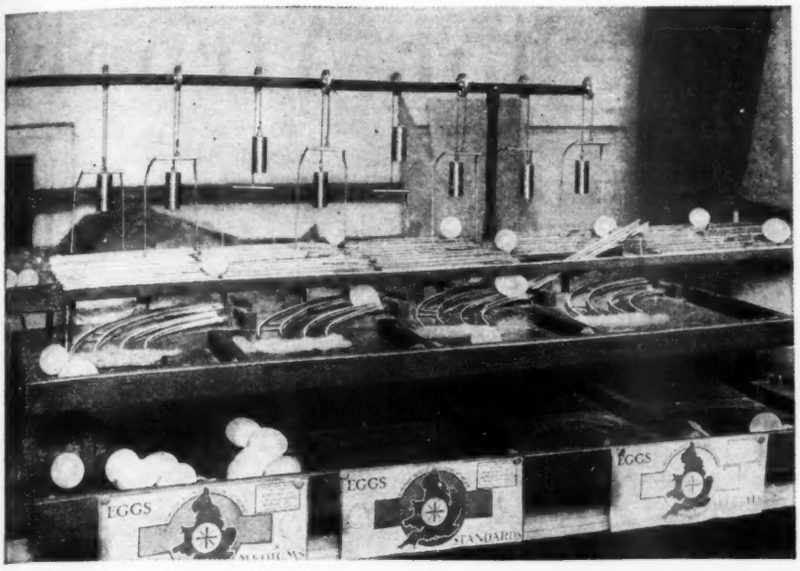
A cigarette holder that does not go in the mouth and yet protects the fingers from tobacco stain is this wide ring of composition material, which fits like a collar around the end of the cigarette where it is held between the first and second fingers of the smoker.



Hay, ensilage, and other farm produce are speedily moved into silo or barn with this novel pneumatic "elevator." Cast into a hopper, the material is carried through a pipe by an air stream which is produced by a gasoline-driven fan.

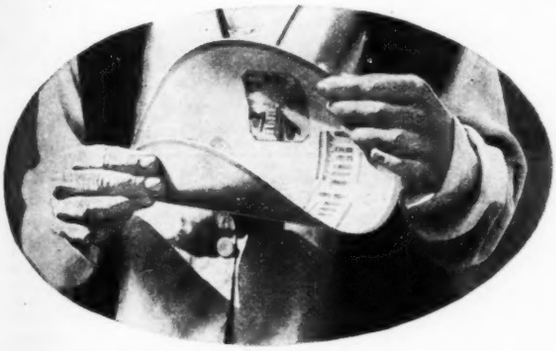
A French inventor's two-purpose cart will be welcomed by mothers who do not wish to leave a child at home when calling. As a go-cart it is pushed in the ordinary way. When the place of the visit is reached it is folded into a car which the child can play with and propel by manipulating two side levers.

Lumber in "packages" is now put out by an enterprising producer. The ends of the boards are accurately squared and finished, saving carpenters much time. The "packages" are fiber caps put on the ends to prevent marring in transit.



A marvelous new egg grading machine recently shown in England is based on the fact that the weight of eggs varies in accordance with their quality and freshness. The eggs roll down tracks divided in sections, each of which is hinged in the middle and so balanced that when an egg above a certain weight reaches it, the track swings downward, permitting the egg to roll to its proper bin.

When the Coast Guard vessel *Marion* recently set off for the north Atlantic to study icebergs it took along this unique instrument, shown by Lieut. Commander E. H. Smith, to raise water from the cold depths so that its peculiarities may be scientifically studied.



After being run over in the street by a motor car and then rolled up and unrolled, a remarkable new talking machine record reproduced music perfectly in a recent demonstration in London. The record, invented by J. Goodson, is flexible so that, no matter how it is folded or bent, it can be restored to its proper shape and the fine impressions which reproduce sound are unchanged.

"Hit-and-run" drivers and traffic law violators generally will not escape so easily if these new luminous automobile license plates, now being tried in Melbourne, Australia, are required by law. The numbers shine out visibly for many blocks. This invention will also serve as an aid to police in identifying stolen automobiles.

Stenographic labor is saved and efficiency increased with the notebook holder and transcription stand seen in the illustration below. The metal back holds the book with a clamp. Sheets fold up and are held under a metal cowl as they are finished and the cowl also carries clips to hold special memoranda. When it is time to transcribe, a folding leg transforms the back into an easel.

This German machine which saves hours of labor wherever money is handled in quantities can take care of a peck of coins. It distributes them by denominations into the bags, counts them, and finally gives the grand total.

"Les" Barker (right), English motorcycle racing champion, shows the helmet he invented for comfort in driving and protection in case of a crash. Goggles drop over eyeholes; slits in the mask admit air. The top protects the skull.

Cities *in* Race for Airports

Bird's-eye view of Lindbergh Field, San Diego's new municipal airport, during recent dedication ceremonies. Swarms of Army and Navy planes are seen flying overhead.

New Engineering Science Shows How to Develop Flying Harbors to Replace Mere "Landing Fields"

By ROBERT E. MARTIN

A BAND was playing in a level, weed-grown field. Near by stood a group of prominent citizens, some of them mumbling the rehearsal of speeches soon to be delivered. Less prominent citizens and their children craned their necks to watch airplanes overhead. Hot dogs, bottled drinks, and ice cream pies were being sold by such hawkers as were not peddling toy "Lindy airplanes" and toy balloons. It was a gala occasion. The local airport was being dedicated.

"Where?" you may ask.

Well, Rockville Centre, a Long Island village, was one place where this happened recently; but it also happened at Towanda, Pa., Colorado Springs, Colo.; Mount Morris, Ill.; Fort Dodge, Iowa; San Diego, Calif.; and Austin, Minn.—all within a few days. It has happened hundreds of times, and during this year will happen hundreds of times again. The latest report of the Aeronautics Division of the U. S. Department of Commerce lists 331 private and commercial airports, 256 intermediate landing fields, 62 Army and 17 Navy aviation fields, 326 marked auxiliary fields, and 754 proposed airports. By this time next year America will have more than 1,700 airports.

At the close of the Civil War, America was a continent more than three months wide; today, by the best trains, it is three days wide; in a few years it will be half a day wide. A few adventurers already have spanned the continent during daylight. It will be no wider than that for all of us when there are suitable airports in every American community.

Lack of good airports is a brake that retards further development of aviation.

Courtesy General Electric Company

Airport design offers a new field in engineering. This scale model for an airport at Schenectady, N. Y., shows arrangement of landing strips, hangars, and administration buildings, in reference to highways, as seen from the air. The field has guiding beacons, boundary markers, and floodlights.

A few of the many we have now are excellently designed and suitably located; but the majority are mere landing fields called "airports" in a booster-spirit courtesy. But a landing field is not an airport.

At this writing Chicago is projecting an airport on reclaimed land on the shore of Lake Michigan. It is closer to the heart of the city than the railroad terminals, and less than five minutes taxicab ride from the best hotels. But the airport which Chicago has been using is more than an hour from the loop district. Cleveland's is nearly as far from the business center. That is something established business cannot permit, because unless the airports are brought to business, business will gravitate to the airports. That happened with railroad terminals, and inevitably it will occur with airline terminals.

IT IS recalled in Missouri today that St. Joseph, Mark Twain's town, adopted a high hat attitude toward the first westward rail line. St. Joseph, as the terminus of the pony express, had been richer and larger than Kansas City. Kansas City, though, went after the railroad—and the railroads came to Kansas City. Today the comparative size of the two cities justifies the vision of the citizens of St. Joe's neighbor.

Then air lines were coming, even as the railroads had come. This time Saint Joe was not asleep. She bought 160 acres of land and built an airport; and Kansas

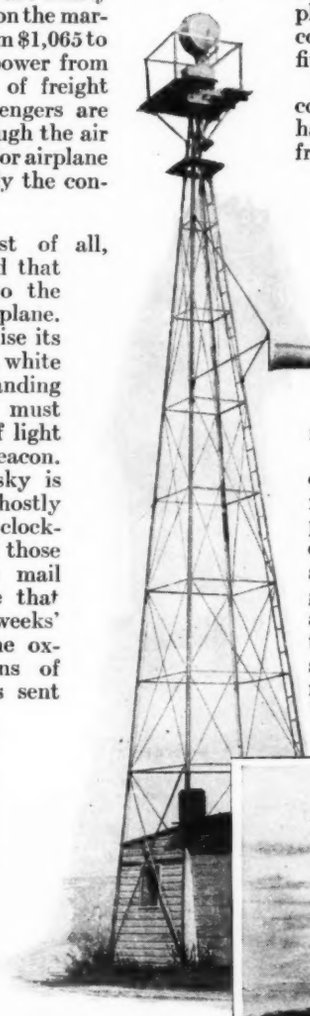
City, forty miles away, lost the distinction of being a stop on the Chicago-Dallas air route.

Rivalries of railroad building days are being revived in multitudes of communities. Hundreds of villages are stirring with freshened hopes of greatness.

Already some 11,000 Americans have learned enough about flying to apply for pilots' licenses. There are nearly ninety airplane models on the market, ranging in price from $1,065 to $60,000, and in horsepower from forty to 1,000. Tons of freight and hundreds of passengers are being transported through the air every day. The means for airplane transport are here; only the conveniences are lacking.

AN AIRPORT, first of all, must be so marked that it is readily visible to the pilot of an approaching plane. By day it must advertise its presence with the great white circle that means "landing field." By night it must swing a silver beam of light against the sky as a beacon.

New York's night sky is riven unceasingly by ghostly fingers of light revolving clockwise. On clear nights those are visible from the mail plane over a distance that would have been a two weeks' journey for one of the ox-drawn covered wagons of pioneer days. One is sent from a twenty-four-inch rotating beacon at Roosevelt Field, Long Island; another from a New York City hotel, and still another from Port Newark, twenty miles away. Cunningly, these lights have been mounted on steel towers so that their thirty-second or sixty-second revolutions shall not interfere with the slumbers of ground folks.



One of the towered beacons that guide night flyers to landing fields. This one is near Burns, Wyoming.

Beacons, however, are but one unit in the intricate lighting system vital to airports. Installed along the runway borders of the best equipped are boundary lights at intervals of about 250 feet, mounted on pipe supports. Red glass globes warn the descending flyer of field obstructions; green globes indicate the best line of approach for landing. Illumination that will transform an airport into a plane of brilliance, yet free from glare, is obtained by means of twin flood lights that confine their beams to a low altitude, and minimizes glare. The beams are directed against the wind, since airplanes must land into the wind. Wind cones also must be illuminated for night flyers, and there must be ceiling lights to show the height of clouds above the ground.

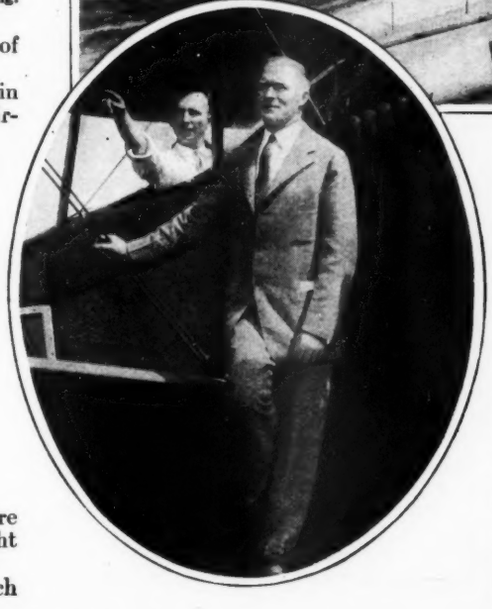
A real airport, though, requires much more than effective lighting. Eleven miles from Detroit is the Dearborn Airport, a Ford enterprise, called by aviators the most convenient and efficient aviation field east of the Mississippi. There 350 acres of field as level as a pool table are inclosed by a high wire fence. From the sky the approaching flyers see a row of rectangular buildings, an airplane factory, an engineering laboratory, a power plant, and a hangar of steel and concrete that can shelter seventy-five planes.

In front of the buildings is a concrete apron 100 feet wide and half a mile long, and radiating from this are three concrete runways, two pointing to the southeast and one into the southwest. One is 3,500 feet long; the other two about a thousand feet each. They provide ideal take-offs. In the space between them the ground has been grubbed free of heavy roots and stumps, harrowed, seeded, and rolled.

The Dearborn Airport has every modern appliance for rapid repairing and servicing of an airplane. Wings can be replaced, engines taken down and reassembled, new propellers applied, gas tanks filled and oil drained and changed with an economy of time that compares well with similar sort of service for automobiles along the highways. When passengers from Chicago or elsewhere debark they find luxurious automobile buses waiting to carry them swiftly to Detroit hotels or railroad stations. Twenty planes arrive and depart from the Dearborn Airport every day except Sunday. Still, Detroit is not satisfied with the arrangement. Her business men are demanding facilities within the heart of the city. The Detroit airport which they are planning will be tied into every other thread of the city's life. It will connect with trains, street cars, taxicabs, buses; and if arriving visitors wish to enter a hotel without delay, the hotel will be there.

LOCATION, then, is the prime convenience. Buffalo has a 518-acre airport eight miles from the heart of the city. It is becoming apparent that either it will have to move into town or that an important part of Buffalo will move out to the airport.

In recent years the New York air mail field has been near New Brunswick, New Jersey, midway between New York City and Philadelphia. It was too far. Overnight air mail that reached Hadley Field at 4:45 A.M. was left lying there for two hours waiting for a train to carry it into New York. That was obviously a stupid waste of time. On October 1, the situation was partially corrected. The New York air mail now is picked up and delivered from Port Newark, a combined landing place for air ships and ocean ships, developed by Newark, N. J. Mail from the West arrives at Newark at 4:45 A.M. Thirty-five minutes later it is being sorted in the New York general post office for morning delivery.

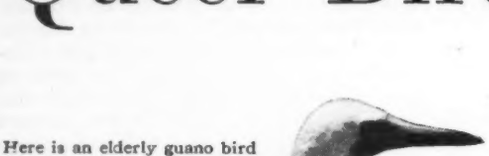


Site of New York City's projected airport on Barren Island. White stretches in the foreground are sand, which will be covered with clay and sod for the landing field. At the left Clarence Chamberlin, trans-Atlantic flyer and superintendent of the project, is pointing out the location of the site to Peter J. Brady, of the New York State Aviation Commission.

In every town where the airport question has not been settled there is a conflict of opinion as to where it should be located. One group of citizens believes that the best location is where land is the cheapest; but almost invariably they are wrong. The best place is where the airport can give the best and safest service.

In the matter of costs, the price of the land per acre is the least consideration. A new kind of engineering is involved here. What will (*Continued on page 152*)

Queer Birds Worth Millions



Here is an elderly guano bird with her eggs, and across the way is a lusty youngster. Most valuable of all birds, their sole use to the world is to fly around, catch fish, and produce tons of fertilizer.

The World's Most Valued Feathered Tribe Fly in Vast Clouds That Hide the Sun. On Their Crowded Island Homes They Supply Fortunes in Farm Fertilizer

By

HOMER CROY

IT'S a queer, strange story about the most valuable bird in the world. The bird is never sold, never skinned nor dressed, its feathers have no use, its eggs serve no useful purpose except to raise more birds, no human being ever ate it, and it is rarely seen by the ordinary person.

It is the guano bird, and it lives off the coast of Peru.

Its sole purpose in the world is to fly around and catch fish, have a good time, raise its young—and produce guano. Guano is used as a fertilizer, and is thirty-three times as strong as barnyard manure. It has supplied a billion dollars' worth of fertilizer for the farmers of Peru, South America, England, and the United States.

The number of birds is amazing. Recently, traveling along the coast of Peru, I was astonished at the unbelievable flocks. One sees them in great black rivers flowing through the air—Gulf Streams of the sky. There are millions and millions of them, turning this way, flowing that way, bending in great curves, then thinning out until they look like a long black rope whipped through the sky by some gigantic hand.

In the late afternoon, just before sunset, the birds are thickest, for they are flying home to their bird islands off the coast of Peru. They obscure the sun like an eclipse. Indeed, they are so numerous that on Central Chincha Island alone they eat one thousand tons of fish a day!

Why are these birds more numerous there than any other place in the world? The answer is the Humboldt Current that flows along the west coast of South America, keeping that section cool, while the east coast is hot and sultry. This cool water is the breeding place of myriads of small fish. The birds eat the fish, live on the uninhabited islands, and produce guano. Very simple, very useful.

Men come and take the guano away. The birds are merely a cog in a machine of turning fish of the Humboldt Current into food for the table and clothes for the back. They might be called converters—fish converters.

Traffic congestion here! When the birds rise to fly the roaring of their wings is like thunder. Workmen's quarters can be seen in the distance.

Workmen filling the sacks. The white is the guano; the black is cleared ground. Here the deposit of guano is about two feet thick.

I made a visit to some of these guano islands and here are some of the queer and unusual things that impressed me:

The tameness of the birds, that was one. As you walk along you can hardly keep them out of your way. It's like going into a chicken yard with a bowl in your hand. If you stand still they will walk on your feet and look up at you, turning their heads from side to side as if saying, "Why, what a queer looking creature this is. I don't believe it can fly at all."

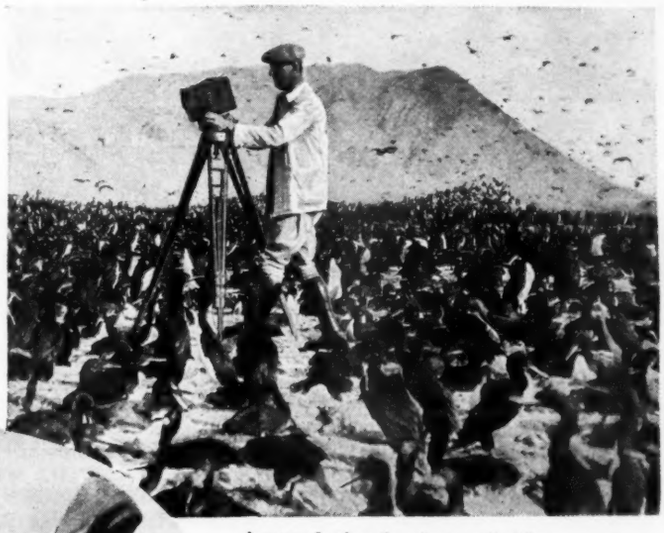
Their sense of hearing doesn't seem to be well developed, and I can understand that it may not be, for the noise of these flocks is deafening. They keep up an incessant chatter and squawking; if they are frightened or start to fly, it sounds like the roaring of a train in a tunnel. If you fire a gun into the air it doesn't frighten them, but if you make a sudden, unexpected movement there will be a beating of wings, a squawking, and away they will fly.

Such a bedlam! Millions on one island, all crowded together, so thick that they cannot all rise at the same time. A few start here, there is a roaring, humming, tearing sound, and another black cloud rises. When they are all at home at one time they cannot walk about, but are like fowls packed in a railroad chicken car.

A queer thing was that these birds seem to have "goats"—that is, birds which they pick on and play jokes on. Whether it is always the same bird I don't know. The flock will be sitting still when all of a sudden one of its members will start a bird running, and the "goat" will make a bee-line through the others with its head held high, screaming at the top of its voice, while all the other birds peck at it. The "goat" bird keeps on going, never ceasing in its wild clamor, until it reaches a cleared space. There it stands, sympathizing with itself, and after a time it creeps back, looking very foolish.

THEY seem to have laws all their own. One concerns the stealing of feathers. Feathers are their money, for nothing grows on these rocky barren islands; not a living twig, not a mouthful of food. The birds prize feathers to soften their nests, so now and then an outlaw bird goes on a feather-stealing expedition. The bird who is robbed sets up a squawking, and then the other birds rush out and, making a terrible noise, set upon the thief.

The birds become encrusted with guano and when it becomes uncomfortable they fly out to the ocean for a bath. They poise above the water, then fly at it at terrific speed. When they strike the water it sounds like the dull report of pistols. They rise again and repeat it time after time, threshing the water with their wings. When a flock is bathing it sounds like distant musketry.



A queer feathered mob poses for the cameraman. The birds are so tame that they'll walk on your feet and have to be kicked away.

Peruvian guano "miners" sewing up the sacks of fertilizer. It takes at least a week for the workmen to become used to the strange odor.

Beyond the railroad, the farmers of Peru hoist the bags of guano on their backs and carry it away to the hills.

Their nests surprised me. Feathers are used to soften them but the nests are of the guano itself beaten into place by the birds' wings. Great, huge nests they are. Often they weigh twelve pounds, and here the birds lay their eggs and raise their young.

But it is not all a life of Riley for the guano birds. One of their worries is the birds of prey that swoop down and eat their eggs. The South American condor is one; he comes from the high Andes. One condor which was killed was found to have sucked twenty eggs into its gullet.

But the guano bird has a friend who helps him fight his enemies. It is the sharpshooter employed by the government of Peru to kill the enemy birds. The condor offers an easy target, but the gulls and vultures are small and they are cunning. However, the sharpshooters know how to deal with them. They take a wounded gull or vulture, tie a bag of sand to its leg, and then leave it. Its cries draw other birds of its kind, and the sharpshooter disposes of them.

So far I have told only about the birds. Now I'll tell something about the guano and how it is handled.

It's not a very pleasant job, mining guano, and only the lowest class of labor goes in for it. When the men are first taken to the islands they are not required to work for a week, for the government knows that it will take them that long to get used to the odor. But after a short time they no longer seem to mind it.

The workmen, with picks and shovels, break up the guano deposits and put it into bags. After they have gathered all they can with shovels, they take stiff brooms and sweep it up, even the dust. The bags are sewed up, put on dummy railroads, and taken to the edge of the islands. The rocky shore of the islands is usually high, and below are the ships to be loaded. Sometimes the bags are sent down through chutes and canvas tunnels, or put on wire trolleys and swung down. After a ship is loaded it sails away with its powerful fertilizer.

After an island has been cleared it takes about thirty months for it to be ready again. So the guano workmen go from island to island, year in and year out, harvesting their strange crop.

Guano is no recent discovery, and its use as a fertilizer is nothing new. It was used by the Incas, in the days before Pizarro came and fastened his bloody yoke upon them. The Incas sailed out in their crude boats, loaded them with guano, and sailed back again. Reaching shore the guano was put into woven baskets and carried by man power high into the mountains, and then scattered on the amazing little terraced farms.

AND it is still being handled that way, in the back regions of Peru. It goes part way by railroad, then the farmers come with their bags and, chewing their coco leaves, start for the high altitudes.

When modern methods were first applied to the gathering of guano it was found, in some places, to be one hundred and fifty feet deep. But today it is allowed to get only a few inches deep before it is gathered.

We stopped at a small house where the workmen lived. It was meal time and the men were sitting at rough tables, eating their food and drinking their wine. On a shelf I noticed two bottles which seemed to be beautifully painted. On one was a beautiful sunset; the other showed a series of mountains, with white caps of snow.

"What do you think those are?" the manager asked.

I did not know.

And then he told me. One of the workmen, with artistic bent, had taken different colored guano, put it into empty wine bottles, and had worked it in so cleverly that it looked liked painting.

And suddenly, in those bottles, I saw how heavily time must hang on the men's hands and the tragedy of having to live always on a guano island.

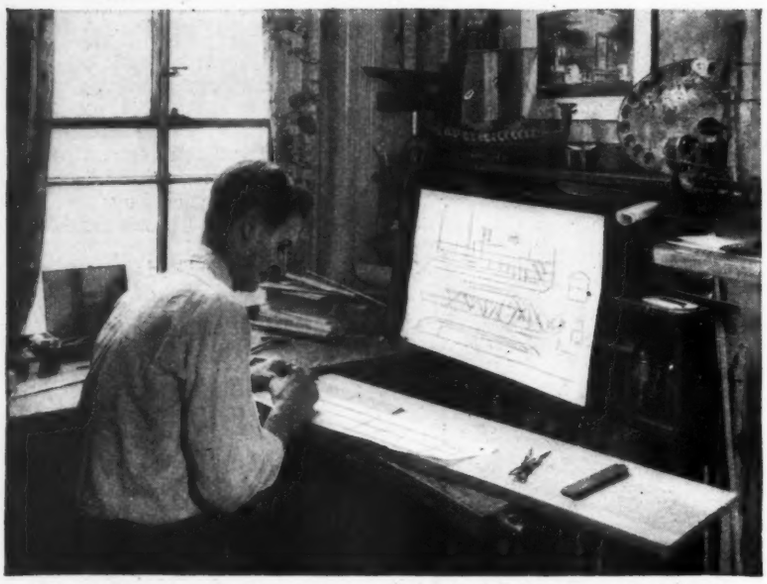
It was late afternoon when we boarded the boat which had taken us to the guano island, and started to steam toward home. The sun was shining brightly, but suddenly it grew dark and a strange, eerie feeling came over me. All about I could hear a deep humming as if a million swarms of bees had set out to sea.

Imagine all the airplanes in America hopping off from a single field in one mighty squadron, and you will have some conception of the unearthly din of that flock of beating wings.

The mate on the boat smiled at my mystification.

"They're going home," he said.

Mississippi Steamboatin'



Captain McCann uses carbon paper to transfer the breadth lines of the hull on a board. He had the builder's original drawings of the *Buckeye State* to guide him.

How to Build a Simplified Model of the Speedy Old Buckeye State, *a Stern-Wheel River Packet—The One Type of Ship Entirely American*

By E. ARMITAGE MCCANN
Master Mariner

ROMANCE has passed from Mississippi steamboatin', but we can preserve a bit of it in our homes by building a model of one of the picturesque, speedy, and in many ways amazing old stern-wheelers that contributed so large a part to the upbuilding of the Middle West.

Those who live in the valley of the Mississippi River or any of its tributaries will need no encouragement to build this model. Those whose homes are to the east or west and have not fallen under the magic spell of river lore, will find the model worth while because it is unusual and picturesque and because the technic of constructing it involves many new, interesting problems.

The Mississippi steamboat is an entirely American product, evolved for the particular conditions under which it had to work—shallow, treacherous water and practically no docking facilities. In this respect it differs from the eight models of historic ships which preceded it in the POPULAR SCIENCE MONTHLY series, for all of them, although intimately associated with American history, were of European build or developed from European designs and therefore chiefly of interest to the sea-minded folk of the Eastern seaboard.

The requirements for a Mississippi boat were—and still are—an extremely shallow hull capable of carrying a heavy load without drawing more than a few feet of water. As the beam had to be narrow, the hulls, though sharp bowed, were given straight sides and flat bottoms. The cantilever principle, as shown in the use of "hog" chains, was employed to prevent the ends from sagging. High speed and the ability to turn quickly were also needed, hence the use of powerful engines, large side or stern paddles, and triple or quadruple rudders.

As there was little space below the water line, the engines, cabins, and everything had to be piled on deck, but this had the further advantage of making the boats light and airy.

In their heyday, before the railroads were built, competition among the boats for passengers was keen. They accordingly were made as attractive as possible; in those days that meant a lot of scroll woodwork, most elaborate saloons and cabins, and gilding and gingerbread.

Because of all these factors, a type of vessel evolved which, although lacking the stately grace of the deep-sea sailing ship, had a beauty of its own in fitness for its purpose.

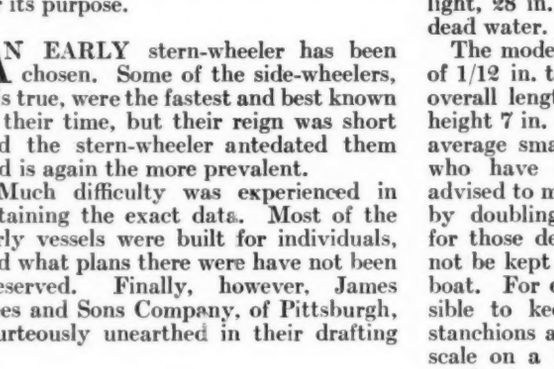
AN EARLY stern-wheeler has been chosen. Some of the side-wheelers, it is true, were the fastest and best known in their time, but their reign was short and the stern-wheeler antedated them and is again the more prevalent.

Much difficulty was experienced in obtaining the exact data. Most of the early vessels were built for individuals, and what plans there were have not been preserved. Finally, however, James Rees and Sons Company, of Pittsburgh, courteously unearthed in their drafting room the lines of the *Buckeye State*, which they built in 1878. With this information, for which I am grateful, and from other facts obtained here and there, together with numerous suggestions given by that earnest and enthusiastic model maker, Frank L. Coes, of Worcester, Mass., I have been able to build what I believe to be a reasonably accurate steamboat of the period.

The *Buckeye State* (Ohio) was a wooden-hull vessel with a length of 235 ft., depth of hold 5 ft., beam 36 ft.; high pressure engines, diameter 18 in., stroke 7 ft., with Rees adjustable or variable cut-off; four boilers, diameter 41 in., length 26 ft.; capacity 900 tons; draft light, 28 in.; speed 15 miles an hour in dead water.

The model has been built to the scale of 1/12 in. to the foot, or 1 in 144. The overall length thus is 19½ in. and the height 7 in. This is a handy size for the average small room, but model makers who have the space would be well advised to make the model twice the size by doubling all measurements, except for those details which obviously could not be kept down to scale on so small a boat. For example, it is almost impossible to keep such parts as the side stanchions and handrails down to exact scale on a 1/12-in. scale model, but it can be done on a 1/6-in. scale model. An alternative method would be to make a model half as large again.

How to mount and display the model will be discussed in detail in the last of this series of articles. In brief, the model may rest flat on a bracket, shelf, or cabinet, or stand on short turned pillars, or be set into imitation water in a scenic display case with a painted



The hull turned upside down to show the shape at the stern. Compare with the drawings on page 124.

"Wooding-up" the *Buckeye State*.

background. The construction of the model will be the same in all cases, except that if it is to be set permanently in "water," the hull from the water line down need not be made.

Little material is required. The hull can be a piece of ⅞-in. pine or other wood. I made the decks of holly, because it is beautifully white, is sufficiently tough, and has no obvious grain, but any clean, white wood will serve. The remainder of the wood is scraps of mahogany, and some whitewood, poplar, or any other semihard wood. Other materials needed are a sheet of good quality cardboard, such as the best artist's bristol board; some scraps of tin, brass, or copper; a little wire; some small brads and ½-in. pins; a very small quantity of light blue, black, and white paint, enamel, or lacquer.

YOU will find a complete list of materials on POPULAR SCIENCE MONTHLY Blueprint No. 96. This is one of three blueprints—Nos. 94, 95, and 96—which have been prepared to make your work easier. They can be obtained for 75 cents from the Blueprint Department, and a coupon for your convenience in ordering them appears on page 100. On the blueprints are full size drawings of all the essential parts of the model and all the information you need to lay out the work accurately and quickly.

While it may be possible to construct a model without full size drawings, I should not attempt it myself and doubt whether any experienced model maker would. Therefore, it is necessary either to prepare your own full size drawings by enlarging the mechanical drawings which will be reproduced in this and following articles—a none-too-easy task even for a skilled draftsman—or make use of the blueprints, which are substantially the same as the drawings I prepared for my own guidance in building the model.

Now let's get to work! On a piece of wood ⅞ by 3 by 17¾ in. draw a line right around the middle. Mark on its upper surface the harpin line shown in the illustration on page 123; this represents the top of the hull. Cut away vertically to this line. On both sides mark the sheer line. The bow end is ⅞ in. above the bottom of the block; the stern end, a scant 11/16 in. Connect these points, not with a straight line but with a true curve. This curve should be a scant 3/16 in. hollow at the center.

SHAVE down to the sheer line. A spokeshave is the handiest tool for this work, but the block can be whittled and sandpapered to shape.

From a piece of cardboard make three templates to the lines given in the body plan (page 124). Shave away the bow until the templates fit at their respective positions shown on the half breadth plan.

The bow is quite sharp at the stem and widens out rapidly until, at 4 in. from the bow, the sides are vertical. From that point aft, only the lower corners are rounded about 3/16 in. up and across.

The stern is more difficult to describe. It will be noted on page 123 that right aft a rectangular piece is cut out; this is a cut 2⅛ in. wide and 5/16 in. deep into the end of the hull. It leaves projecting horns on either side. (*Continued on page 123*)

RIVER PACKETS RACE ONCE MORE

STIRRING accounts and photographs of a race between the steam packets *Betsy Ann* and *Chris Green* on the Ohio River were published in the newspapers recently. The nation-wide interest that was taken in the race was akin to the enthusiasm that has greeted the revival of show boat days and plays—on the stage, in the movies, and, indeed, on the boats themselves. The growing list of stories about Mississippi steamboatin' is another indication of what the old packets meant in the life of the Valley. And if you, too, have in you the love of river lore, you will want to build the *Buckeye State*.

Better Ways to Do Woodwork

How to Lay Out, Saw, and Plane Boards and Make Doweled Joints —Hints on Furniture Building and Odd Jobs

By EDWIN M. LOVE

Scribing a line along the inner edge of a steel framing square.

A MOMENT of great anticipation! The home mechanic removes the clamps from his assembled radio cabinet and prepares to give it a last cleaning before applying the paint, varnish, or lacquer. What does his inspection show?

Does he mutter under his breath and reach for the plastic wood, putty, glue and sawdust, or powdered-brick crack filler, or does he smile with pleasure as he finds every joint tight and the broad surface free from mars? Much depends on whether or not he has done his work "decently and in order."

By taking thought, any amateur woodworker can do craftsmanlike work. Probably as many mistakes come through improper laying out as through unskillful handling of tools.

Lumber, as it comes to the mechanic these days, is generally of uniform thickness and often flat enough for cabinet building. Nevertheless, in the order of the work, it should be treated as if the sides were not parallel.

One side, usually the better, should be lightly marked with an "X" to identify it as a face side. It is against this side and only this side that the try-square is held for testing the edges. An edge, jointed (planed) straight and square, is likewise taken for a working edge; against this the square is held for marking the ends to be sawed off.

The wise amateur avoids a pencil in laying out. He uses a sharp knife or an awl point. A soft pencil makes a line that is easy to see, but there its virtues end, for a saw wobbling from side to side on it may vary as much as 1/16 in. A hard pencil is better; but a knife point locates a measurement exactly.

When the framing square is used, the marking tool should trace along the inner edge that rests against the wood rather than against the outer edge, which does not touch the surface of the wood and therefore allows the point to vary. If carefully sawed along a well-scribed line, the end of the board will be square with the face edge. The other edge may be located either by accurate measurement at the ends—useful especially if it is not to be parallel with the working edge—or by gaging.

Two difficulties beset the man who joints the edge of a board. The plane may scoop out the center, leaving the ends high; or more commonly, it may reduce the ends while leaving the center.

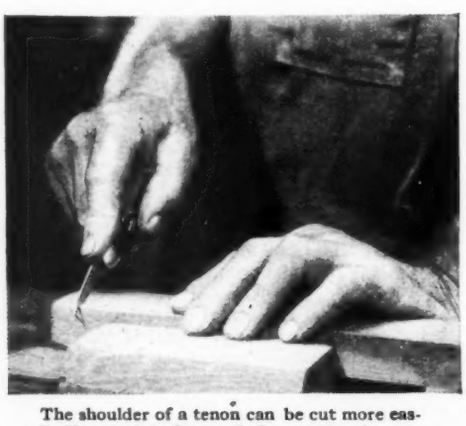
In the first case, the jointer plane is probably so dull that it chatters at the start, and the user unconsciously confines his efforts to the center, where the plane rides easily. The remedy is to hone the plane iron and take shavings at the ends of the board until the edge is fairly straight, and then to finish with full-length cuts. In the second, the heel of the plane is dropped at the start, and the toe at the end of the stroke, with the result that gradually the ends are "dubbed" off. If the plane is lifted bodily at the end and carried back, a straight edge is more likely to result. Incidentally, the wear on the plane iron is cut nearly in half.

How to lift a jointer plane at the end of a stroke to prevent "dubbing" or slightly rounding the corner.

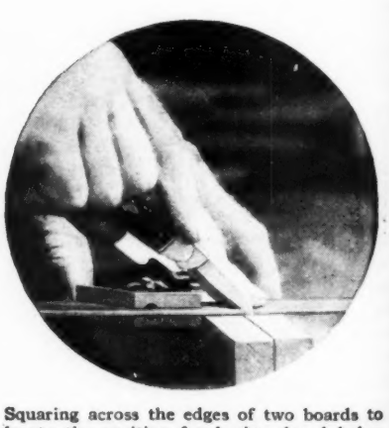
Accurate measurements depend upon accurate measuring sticks. If the various parts of a cabinet are measured with a square, inaccuracies in reading may cause slight variations in the relative length or width of the mating parts, making their assembly difficult or even impossible.

In simple cabinets, it is better to lay out one part and take from it the corresponding measurements on other parts. For pieces that (*Continued on page 133*)

Laying out a measuring rod for a piece of furniture with the square held vertically.



The shoulder of a tenon can be cut more easily if a notch is first made for starting the saw.



Squaring across the edges of two boards to locate the position for boring dowel holes.

Grace and Color Distinguish This

FIREPLACE SPARK SCREEN

Yet It Can Be Made at Trifling Cost and No Great Labor with the Tools Found in Every Home

By BEN WELLWOOD

Charming as this fireplace screen is, no special skill in metal work is required to construct it. The silhouette is sheet iron, bronzed and colored.

NOTHING sets off a fireplace better than an artistically designed fireplace screen. High prices are asked for screens that have a decorative, handmade appearance, but the actual cost of the materials in even the best of them is relatively small. The amateur craftsman therefore can make a screen for far less than he can buy one. For example, the screen illustrated cost only $3.05 for the iron, brass, screening, and hardware.

The screen is 26 in. high and 30 in. long. It laps over the brickwork of the fireplace opening 1 in. on the top and sides. The materials required are 9 ft. 4 in. of ¾-in. band iron and the same amount ⅜-in. band brass; 28 in. of No. 16 mesh bronze screening 32 in. wide; 3 doz. brass nails 1 in. long; 1 sheet of galvanized iron 26 by 32 in.; 2 bronzed ornaments and 1 ornamental bronzed handle. The band iron may be obtained at any blacksmith shop, the remainder of the materials at a hardware store.

The first step is shaping the frame. Cut a cardboard or thin wooden template for the corners as shown in Fig. 2. A full size outline of the frame drawn with chalk on the floor will expedite the shaping process. Take the 9 ft. 4 in. length of ¾-in. band iron and mark a point 15 in. from the end. Here form one of the lower corners of the frame and check the bend with a large square. Then place a mark 21 in. from the corner and make a bend for one of the upper corners, using two large monkey wrenches as shown in Fig. 1. Bend the remaining corners so that the frame fits the outline on the floor. The ends will meet in the center at the bottom if the bends have been made accurately.

The inner brass frame is in two sections: the two sides and bottom are in one piece, and the top with the two curved ends is in the other. The ⅜-in. brass can be shaped readily by hand.

Hold the brass and iron frames together with C-clamps and use a 3/16-in. drill to make a series of holes through them 3 in. from center to center, as in Fig. 3. The screening is inserted between the frames. Tongues of the silhouetted design — to be described later — are clamped with the screening between the frames.

The screen is fastened first at the top and one side of the brass frame. Slip the brass nails through the holes and the wire mesh after cutting off the nails so that they will project ⅛ in. beyond the frame for riveting. If facilities for riveting are lacking, merely bend over the brass nails and hammer them flat. Next pull the screening through the lower part of the frame and fasten it similarly in place. Little pressure is necessary; too much may cause the screening to break at the top.

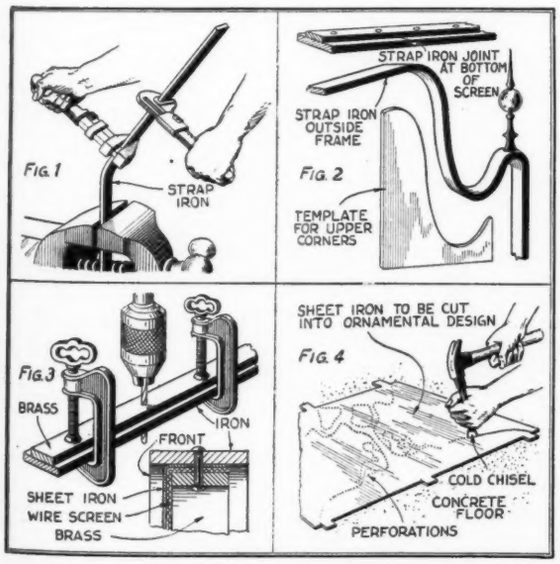
An old brass bedstead may furnish the ornaments, and it is sometimes possible to obtain suitable ornaments from dealers in hardware specialties. However, they are not essential, although they do give a desirable delicacy of line.

NOW that the frame is assembled, all that remains is to make the silhouetted design. A full size outline drawing should be pasted on the galvanized iron as shown in Fig. 4. Place the iron on a cement floor or other firm support and perforate the outline with a nail set, the holes being as close together as possible. Then detach the design with a ½-in. cold chisel. The fact that the outline is irregular or corrugated is no disadvantage.

Attach the design by bending the tongues between the brass and iron frames. If the sheet metal design does not lie flat against the bronze screen, fasten it with a few "stitches" of thin copper wire, twisted at the back of the screen.

A simple way to finish the screen is to apply one coat of red lead and when this is thoroughly dry give it a coat of clear varnish mixed with bronzing powder. While the varnish is still wet it can be stippled or mottled with burnt sienna oil color to produce a two-tone bronze effect. It is somewhat difficult to make paint adhere properly to newly galvanized metal, so the red lead must be brushed on with a good deal of vigor and pressure.

The screen is held in position by driving a piece of ⅜ in. wide brass between the first course of mortar and the iron lintel of the fireplace and bending it so that it laps over and holds the frame like a spring catch. If legs are desired, they can be shaped from ¾-in. band iron.



Bending strap iron (Fig. 1); ornamental corner (Fig. 2); drilling the frame (Fig. 3); cutting the silhouette with a chisel (Fig. 4).

Auroras *Shot from the* Sun

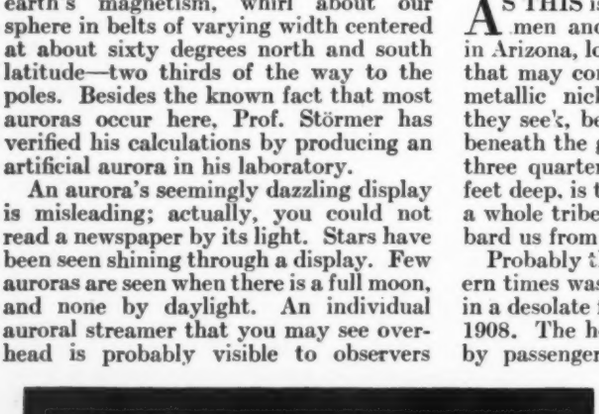
Mysteries of Northern Lights Explained—A $50,000 Search for a Meteorite—Discoveries and New Events in Astronomy

A magnificent auroral curtain sweeping across the sky. Its lower edge is about seventy miles above the earth, while its highest streamers may reach up six hundred miles high.

WHAT makes auroras? "The sun!" is the latest answer, given by Prof. Carl Störmer, Norwegian astronomer. Like a mighty siege gun bombarding the earth with buckshot, every sunspot that crosses the face of Old Sol pelts the earth with a hail of electrified particles. When they strike the earth's atmosphere they flash into the brilliant displays we know as the mysterious northern lights.

Often the colored electric fires of the sky invade temperate regions—about one out of ten auroras is visible as far south as the middle of the United States. An aurora can cover practically the whole earth at once; the aurora borealis, or northern lights, and the aurora australis, seen by those in the southern hemisphere, may be witnessed simultaneously. Prof. Störmer recently demonstrated by scientific models of the path of particles shot by the sun that these, caught by the earth's magnetism, whirl about our sphere in belts of varying width centered at about sixty degrees north and south latitude—two thirds of the way to the poles. Besides the known fact that most auroras occur here, Prof. Störmer has verified his calculations by producing an artificial aurora in his laboratory.

An aurora's seemingly dazzling display is misleading; actually, you could not read a newspaper by its light. Stars have been seen shining through a display. Few auroras are seen when there is a full moon, and none by daylight. An individual auroral streamer that you may see overhead is probably visible to observers within about a five-hundred-mile radius.



This brilliant display of aurora borealis was photographed in Norway by Prof. Carl Störmer. He believes auroras are caused by bombardments of electrified particles from the sun.

Experts are now working on the last of the aurora's mysteries—the curious green line seen in its light when analyzed with a spectroscope. Recently Dr. Gunther Cario and Dr. Joseph Kaplan, at Princeton University, have produced brilliant duplicates of the auroral green line and of another red line recently discovered in the aurora's spectrum, using a mixture of oxygen and nitrogen—suggesting that "active nitrogen," present also in explosives and fertilizers, may be the source.

Hunting a Huge Meteorite

AS THIS is written, a $50,000 party of men and machines is digging a hole in Arizona, looking for a fabled meteorite that may contain $500,000,000 worth of metallic nickel. The heavenly visitor they seek, believed to have buried itself beneath the great Canyon Diablo crater, three quarters of a mile across and 600 feet deep, is thought to be the greatest of a whole tribe of stray missiles that bombard us from the sky.

Probably the largest meteorite of modern times was that seen to crash to earth in a desolate forest of Yenissei, Siberia, in 1908. The heat and shock of it was felt by passengers in a train four hundred miles away. It has not been recovered. The largest meteorite ever found, a fifty-ton monster, is in Bacubirto, Mexico.

Experts say that falling meteorites, as they blaze through the air at twenty or thirty miles an hour, are fused to white heat at their surface by air friction; yet their interiors are extremely frigid—more than four hundred degrees below zero, which is approximately the temperature of outer space. One meteorite, falling on marshy ground in India is said to have instantly frozen fast!

How the Moon Is Measured

"AS BIG as a silver dollar" is a romantic but not very satisfactory description of the size of the full moon. In order to compare heavenly objects and distances more accurately, astronomers use an ingenious and simple system of measurement.

The entire semicircle from one horizon, across the sky to the opposite one—the summer path of sun as it sweeps across the heavens—is divided into 180 "degrees." These may be measured off in any direction, and indicate, not an actual distance, but the angle through which a telescope is swung in crossing from one side of a celestial body to the other.

Our moon, for example, when full is said to have an "apparent diameter" of about half a degree.

Two Solar Eclipses Coming

ONE of the greatest astronomical spectacles of the near future will occur in September, 1932, when New York and New England will witness a total eclipse of the sun. Under favorable weather conditions, it will be seen by as many persons as that of January, 1925. The International Astronomical Union, whose members from all over the world meet every three years, will hold its 1932 gathering in the United States in order to be present at the event.

The path of the eclipse, as calculated by L. J. Comrie, British astronomer, will come down from Canada and cross New England in a bell-shaped area about 100 miles wide. The southwest edge will graze Montreal and Salem, Mass. Totality, when the sun is completely hidden, will occur about 3:30 P. M., and will last one minute and forty seconds.

Western parts of the United States will see an unusual astronomical event on April 28, 1930—a "central" eclipse of the sun. Along a path through California, Nevada, and Idaho the eclipse will be total; but northern Montana will see an "annular" eclipse, in which the moon's disk leaves a ring- (*Continued on page 174*)

New Triumphs *over* Friction

Magic Oil Films Let Industry's Engines Roar at Amazing Speeds

By GEORGE LEE DOWD, JR.

MAJESTIC in its towering rigidity, the largest dock gate in the world swings open to admit an ocean liner. It is the most impressive feature of the new $35,000,000 Gladstone Dock, pride of Liverpool, England. Five hundred tons of steel, propelled by unseen machinery, recede silently and smoothly on massive bearings before the incoming vessel.

That it should be possible to swing a veritable skyscraper of metal is a miracle of modern engineering. It is one evidence of modern progress in conquering friction—the arch enemy of all moving things, the same grinding force that halts railroad cars with "hot boxes" and scorches meteorites to incandescence.

What is this strange force? Other forces, magnetism and gravity, for instance, are servants of man, driving his machines. But friction is a parasite. It preys upon the driving forces and wastes them. The second that a wheel or shaft starts turning, up leaps friction to stop it. No wonder, then, that engineers seek to harness friction in the brakes of motor cars and railway trains—and to defeat it wherever it hampers industry. How well have they succeeded?

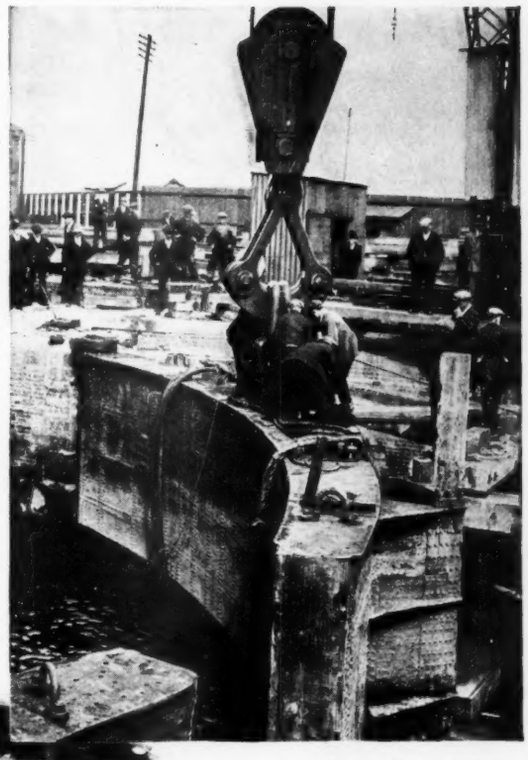
Two barrels of oil flow every minute, as this is written, through the bearings of a great steam turbine in a Springdale, Pa., power house, so that the rim of its fifty-seven-ton rotor can whiz at ten-mile-a-minute speed. At the Mount Wilson Observatory, in California, the world's largest telescope and its 100-ton mount swing without a jar upon the practically frictionless surface of a tank of mercury. And in each of the 70,000-horsepower hydroelectric units at Niagara Falls, largest of their kind, a single "thrust bearing" supports upon a film of oil the 1,100,000-pound weight of a giant generator armature and water wheel—a weight that four of the world's most powerful locomotives could barely lift—and does it so smoothly that the whole mighty shaft, under the impact of tons of water, can whirl more than a hundred times a minute without danger of grinding its support to bits.

Come with me into the engine room of a great steamship. In the grip of the main bearing, the turning propeller shaft transmits the impulses of the engine to the screw. Into a hole in the side of the great bearing, an engineer thrusts his hand, feeling the shaft to see if it is too hot. The oil is getting low, and he replenishes the cups from which it drips upon the shaft to form a protecting coat.

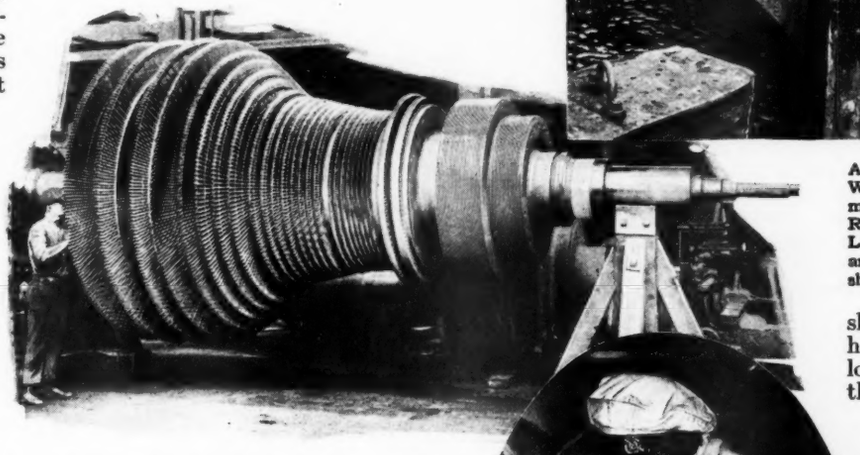
Probably the mightiest bearings are those of tropical sugar mills, which must stand the grinding of huge rollers that crush the sap out of matted cane. Great journals of bronze are these, and oil that lubricates them is pumped in by powerful steam-driven compressors.

So, throughout industry, the fight against friction is never-ending. Sometimes a whirling ring splashes oil over the bearing; elsewhere, wicks drip it on. Graphite, called the world's greatest solid lubricant, may take the place of oil when heavy metal surfaces grind together, as in automobile spring leaves. Ways have been found, too, to force lead and copper into porous graphite, forming an alloy of

(*Continued on page 157*)

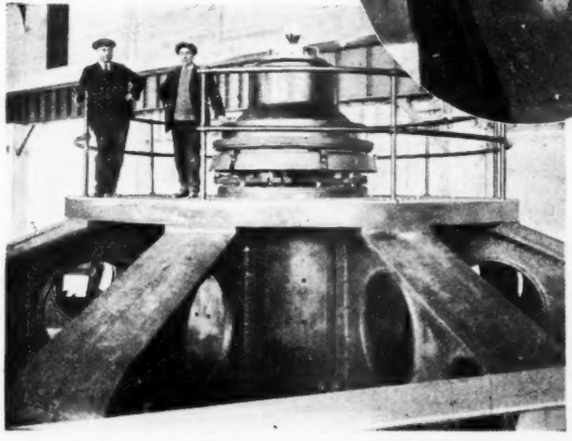


A victory over friction. Weighing 140 tons, this mammoth dock gate at the Royal Victoria Docks, London, swings smoothly and evenly on the bearing shown at the extreme left.



Two barrels of oil a minute in the bearings of this 57-ton steam turbine rotor at Springdale, Pa., enable its rim to whirl at ten miles a minute!

Right: Testing the temperature of a steamship's main bearing. The engineman thrusts his hand in to see if the propeller shaft is too hot.

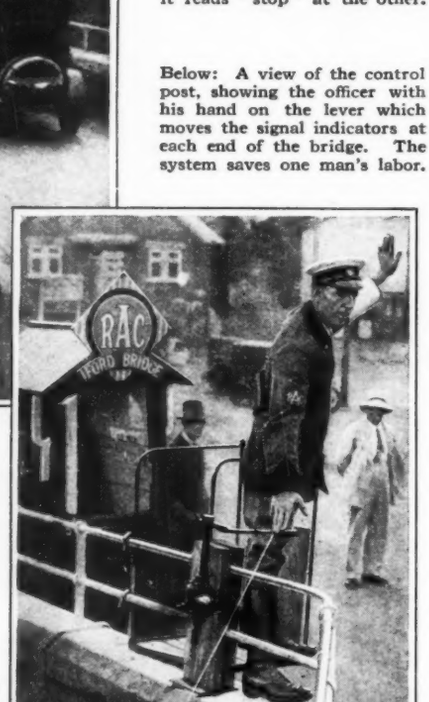


This single bell-shaped bearing of a Niagara Falls hydroelectric unit supports a million-pound weight whirling 100 times a minute.

Invents One-Man Control of Bridge Traffic

Left: The ingenious signal invented for one-man control of one-way traffic across a narrow bridge in Hampshire, England. A lever moves the indicator at each end of the bridge. Thus, when it reads "go" at one end, it reads "stop" at the other.

Below: A view of the control post, showing the officer with his hand on the lever which moves the signal indicators at each end of the bridge. The system saves one man's labor.



TRAFFIC from both ends of a narrow bridge wide enough for only one car, in Hampshire, England, is controlled by one man through an invention perfected by F. D. Blachford, a traffic guide of the Royal Automobile Club.

The operator sits in a raised tower at one end of the bridge, and with a lever swings an indicator at the opposite end alternately to "go" and "stop."

When the indicator at one end of the bridge allows the cars to proceed, the operator at the other end signals "stop." Thus he can control traffic one way at a time by a single movement. This does away with the necessity of having a man stationed at each end of the structure.

Longer Life for Heaters

LONGER life and higher efficiency for electric toasters, irons, and heaters of all kinds is promised, according to the Westinghouse Electric and Manufacturing Company, by a new insulating compound just developed in its laboratories. Curiously, the silvery metal magnesium, a good conductor of electricity instead of an insulator, is used in the manufacture of the substance.

The new insulator replaces mica or asbestos to keep stray electric currents from leaping across gaps between heating coils. It is made by winding ribbon of metallic magnesium around an electric wire and inserting the wrapped wire in a tube, where both are given a bath of steam at 450 pounds pressure. The result is a hard, white material, an oxide of magnesium, that can be formed in any desired shape.

Rubber Pads Silence Trains

SO SUCCESSFUL have rubber pads proved as shock-absorbers and silencers for railroad trains, after a test on one rail length of a Federated Malay States railroad, that they are to be tried on longer stretches of track. The rubber, which is made by special process, was found to deaden the sound of the clinking of rails within the coaches, and to absorb practically all vibration.

Submarine, Stuck in Mud, Saved by Sister Ship

SOMETHING new in submarine rescues occurred in Italian waters the other day, when the undersea craft *N-34*, commanded by Lieut. Perrucchetti, became mired in mud at the sea bottom off Rome. Captain Perrucchetti, brother of the *N-34* commander, was standing by with his new 2,000-ton submersible *Ballilla*, when he learned by undersea signal of the sister ship's fate.

Without waiting for orders, the latter dove his ship to the spot where the *N-34* lay stuck in the ooze. Gently ramming it, he succeeded in nosing it out of the mud and it rose to the surface. The *Ballilla* itself became mired, but freed itself by its own power. For failure to report the accident first to higher authorities, and going to the rescue himself instead, Capt. Perrucchetti was ordered to prison, but later was freed and honored for his feat.

Television to Wield Baton

TELEVISION soon will play a part in solving a puzzling problem for the orchestra leader, according to Fritz Reiner, conductor of the Cincinnati Symphony Orchestra. A symphony to be presented calls, at one point, not only for a full orchestra on the stage, but also for a second orchestra hidden from view in back of the stage to provide faint strains of music as from a distance.

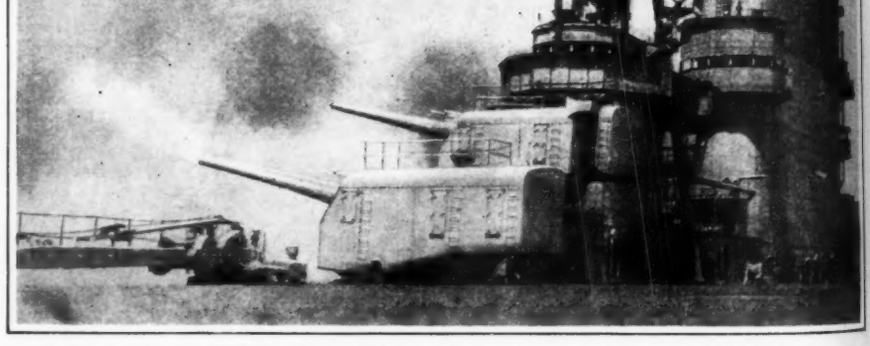
During a concert, Conductor Reiner, leading the main orchestra, says that he will transmit his image by television to the concealed musicians so that they, too, can keep time with his moving baton.

U. S. Aircraft Carrier Tests Her Big Guns

A CRASHING salvo from the U.S.S. *Lexington*'s new eight-inch guns was the recent climax of four years' effort by ordnance experts of the Navy to perfect the huge armament for installation on aircraft carriers.

This photograph, first ever made of the *Lexington*'s big guns and turrets in action, vividly shows how a carrier, "eyes of the Navy" through its covey of observation planes, may become a formidable battleship as well. It was taken during battle practice off San Clemente Island on the Pacific coast.

The *Lexington*, with its twin aircraft carrier, the *Saratoga*, are the largest ships ever built in the United States. Both are all-electric in operation and can carry a fleet of more than eighty planes. The landing field provided by the deck of this mother ship for aerial fighters is nearly nine hundred feet in length.



The U. S. aircraft carrier *Lexington* firing a salvo from her new armament of eight-inch guns.

Tests Reveal Some Common Errors in Knowledge

DO YOU know why winter is colder than summer? How deep scuttled ships sink in the sea? Why air in a close room gets bad? If you do, you cannot be caught in pitfalls of ignorance that trap many a man of more than average education, as disclosed by a recent New York survey of college graduates and others presumably well informed.

The first question was the one that caught the most people. More than four fifths of those questioned declared that winter is colder than summer because the sun is then farther away. But they were wrong. The sun's distance has nothing to do with the question (actually it happens to be nearer in winter); the real reason lies in the earth's changing slant which brings the sun directly overhead in summer, and lower in the sky in winter.

A surprisingly common error was the notion that sunken ships do not go to the bottom, but float at some midway level. The reason heavy objects sink is because they are denser than water, and they sink clear to the bottom of the water because water's density remains virtually unchanged despite the enormous pressures encountered at great depths.

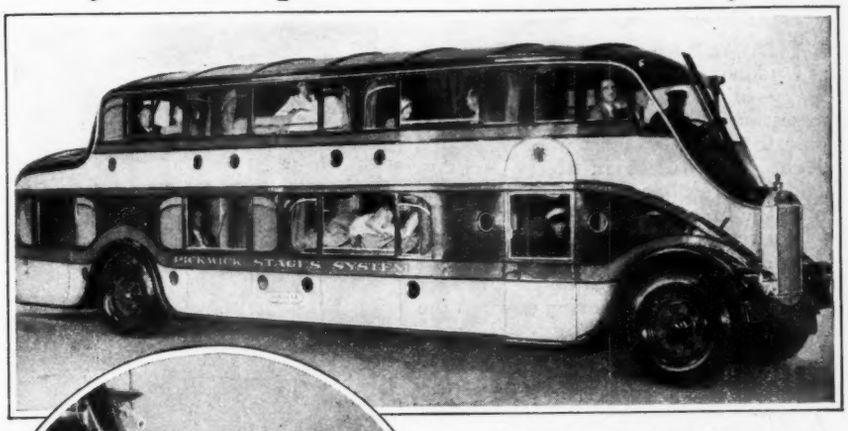
Air in a close room gets bad, not because of carbon dioxide gas exhaled by its occupants, as many supposed, but because of the gradual exhaustion of the oxygen contained in the air.

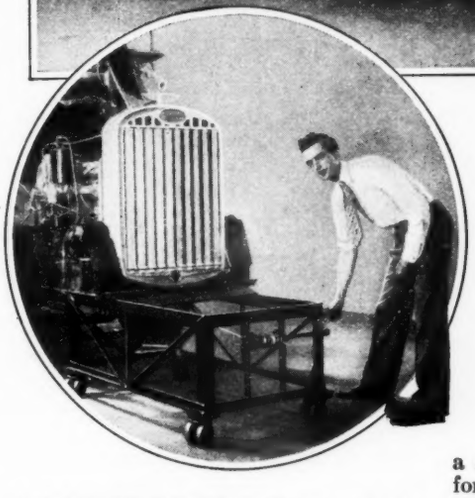
Other common misbeliefs were that a tree always shows one growth ring for each year of its life, and that Hannibal made a road across the Alps by dissolving the rocks with vinegar.

Billion for Army Aviation

SINCE its $50,000 grant to Samuel Pierpont Langley to develop a flying machine, on which preliminary experiments were made in 1899, up to the present day, the U. S. Army has spent more than $1,000,000,000 on aviation, according to figures just announced by the aeronautics branch of the Department of Commerce.

Twenty-Six Sleep in New Cross-Country Bus





The huge transcontinental bus has thirteen compartments with all sleeping car luxuries. Note driver's seat above engine. Left: How the power plant is removed.

A DOUBLE-DECK Pullman of the highways, providing berths for twenty-six people and hot meals during the long journey, recently was completed for service between Los Angeles, Calif., and Philadelphia, Pa. Each of its thirteen compartments has, among other conveniences, a wash basin with running water and a built-in thermos bottle to add to the comfort of the passengers. At the back of the coach is a lavatory, and in front, beside the driver, is an observation seat.

The body of the huge, all-metal, seventon coach is made of duralumin to cut down weight, and it is streamlined to increase speed. It is thirty-four feet four inches long and eight feet wide. Although it has two decks, it is only ten feet three inches high. The driver is seated above the motor, which has no hood as in an ordinary motor coach.

A unique feature of the machine is its detachable motor. At certain points during its long run, the motor will be removed and a new one substituted. This requires but a short delay and eliminates long stops for overhauling during the trip.

Besides the driver, a porter and a chef are included in the crew. The only stops required will be those to service the machine. Thus it is expected that hours will be cut from the present motor-coach time across the continent.

Calls Atom Power a Dream

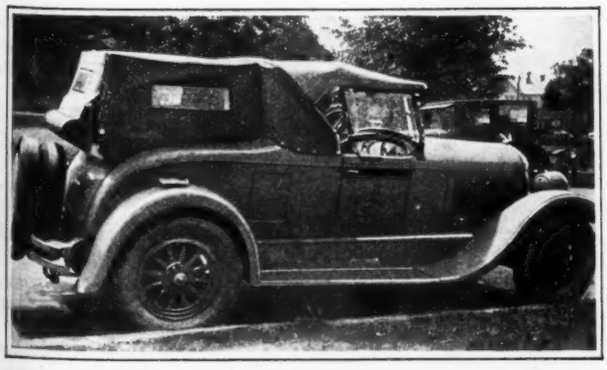
FROM the sun must come the energy that will run the world for the next billion years, as it has in the past, Dr. R. A. Millikan, famous for his researches on star-born "cosmic rays," recently declared. Harnessing the energy supposed to reside within atoms of matter, Dr. Millikan said, is "a childish Utopian dream," and the idea that chemists might wreck the world by unlocking it "a foolish bug-a-boo."

His studies of the extraordinarily penetrating rays he has detected coming from the stars, described in the July POPULAR SCIENCE MONTHLY, have convinced him, he says, that the world has existed for a billion years already, with every prospect of man's continued existence for another billion years.

Folding Cover Protects Rumble Seat Riders

NO LONGER need the occupants of an automobile rumble seat be at the mercy of the weather. A new cover in the form of a canvas hood unfolds at a moment's notice from a container on the back of the car. Its side and back curtains contain windows; the whole is made in one piece and is fastened with spring clasps. Adequate ventilation is obtained by removing the rear curtain on a roadster top, or opening the rear window on a coupé model. Or the sides of the curtain may be folded back if desired. In a test it was raised and secured without difficulty in a car moving at a speed of fifty miles an hour.

The rumble seat cover is manufactured of various types and colors of fabrics, to harmonize with the top material of the automobile on which it is to be installed.



The canvas top in place over the rumble seat. It is unfolded from a container at the rear, and is fastened in position with spring clips.

The Rotor Ship Passes

REMOVAL of curious wind towers that drove the steamship *Baden-Baden*, and substitution of a prosaic Diesel engine, has just marked the passing of the Flettner rotors as a commercial test.

Anton Flettner's idea was to utilize a part of the wind's unbounded energy to drive ships; in short, to use spinning towers as sails to drive vessels. Craft actually ran, propelled by the rotors. In the long run, however, it was found that these apparently could not commercially rival more conventional forms of power.

Hundred-Foot Fire Ladder Raised by Motors

MILWAUKEE firemen need no airplanes these days to get the thrills of sky riding. They have just come into possession of a new telescoping ladder, imported from Germany, which rises to a height of 100 feet in thirty seconds. Raised by gasoline motors, it is believed to be the tallest ladder of its kind.

In a recent public demonstration, one of the firemen tested the ladder for himself by perching on the swaying tip, high above the street, and waving down to the assembled spectators.

Raising the 100-foot fire ladder in a public test at Milwaukee. Note the fireman on the tiptop.

Build Highest Earth Dam

A RESERVOIR which will add twenty-two billion gallons of pure water to the supply of Springfield, Mass., will result from the construction of the world's highest earth dam, forming a giant plug in a gorge of the Little River at Cobble Mountain, in the southwestern part of Massachusetts.

The new dam will rise 245 feet above the bed of the stream, and will top by thirteen feet the next highest structure of the kind, the Tieton Dam, in Washington. It will be fifty feet thick at the top and 1,505 feet thick at the base. Into the construction will go 1,800,000 cubic yards of material. The core will be of clay, with sand, gravel, and boulders dumped against it to form the main bulk.

The water it will hold back is expected to cover 1,120 acres.

An Icy Stream in the Sea

A CURRENT of icy water sweeping down the Atlantic with an average width of 110 miles—greater than the distance between New York and Philadelphia—that is the Labrador current as revealed by surveys made by the U. S. Coast Guard Oceanographic Expedition.

The expedition sailed from Sidney, Nova Scotia, July 16, in the Government vessel *Marion* to cruise between Greenland and Labrador to study icebergs. The nearness of the Labrador current to warm currents from the tropics is said to account for the frequent fogs over the Newfoundland Banks. One theory for the existence of ocean currents is that winds, blowing in the same direction year after year, communicate motion, through friction, to the water below.

Banker Invents a Camera to Record Checks

TO PROTECT banks and depositors, George L. McCarthy, a former banker of New York City, has invented a new camera which photographs automatically every check cashed or deposited. The instrument can be adapted to any standard adding machine, making a photographic record of every check as it is listed. It carries a roll of film 200 feet long, sufficient to photograph sixteen thousand checks.

The file number of each check is included in the picture and thus the location of any particular check at a later time is made easier.

If desired, the machine will take two photographs of each check, the pictures being made on different rolls of film. The exposed film may be removed at the end of each day, leaving the unused portion for use the following day. The camera can be loaded in daylight. It may be run independently of the adding machine.

The inventor with his film roll which records 16,000 checks.

Dines on Feathers

A STRANGE bird that eats its own feathers is one of 188 specimens living in Porto Rico, reported recently by Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution. It is the Antillean grebe, a common bird of the island.

Every specimen examined by Dr. Wetmore had masses of feathers in its stomach. They had been plucked and swallowed and apparently digested.

A Huge Dynamite Blast

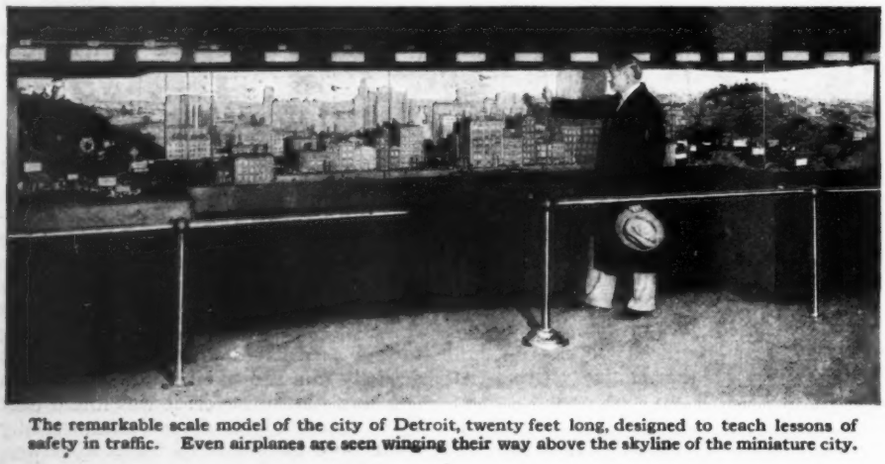
THE explosion of one hundred thousand pounds of dynamite, the biggest blast ever set off in the Pennsylvania coal fields, recently loosened more than 200,000 cubic yards of earth near Hazelton, Pa. It enabled steam shovels to remove the material above a rich vein of coal.

Although the tremendous explosion occurred within three miles of the town, it caused no damage nor injury.

Model City Gives a Lesson in Safety

COMPLETE even to "hot dog" stands and traffic policemen, a remarkable model of the city of Detroit has been on display this year in towns throughout the state of Michigan. Its purpose is to teach the lessons of safe driving graphically and entertainingly.

The model, twenty feet long, constructed by a New York firm of scenic artists, shows factories in operation, automobiles scurrying through the streets, and boats plying the Detroit River. Miniature street traffic signals are shown in operation, and realistic automobile "smash-ups" show how accidents result from violations of traffic regulations.



The remarkable scale model of the city of Detroit, twenty feet long, designed to teach lessons of safety in traffic. Even airplanes are seen winging their way above the skyline of the miniature city.

"Phone Box" Takes Movies of Bank Robbers

AN AUTOMATIC, invisible, and silent moving picture camera, housed within an innocent-looking telephone case, is designed to be the undoing of hold-up men. Its inventor, John E. Seebold, of Los Angeles, Calif., is shown below with the new apparatus. In a recent demonstration before a group of bankers, it obtained clear movies of people in a bank who were unaware of its presence.

Sixteen feet of film is carried and the camera can be focused for any distance up to eighty-five feet. The inventor proposes to install the device in banks, where it can be tripped off during a hold-up to give a picture of the criminal and his movements and other characteristics which will aid in his detection.

Huge Scale Sets Standard

A RAILROAD scale, so large it will weigh a 120,000-pound box car, and so sensitive it will show the change in weight if a sparrow alights on the car, has been built for the Chicago Belt Line by the U. S. Bureau of Standards. It will record down to one tenth of a pound.

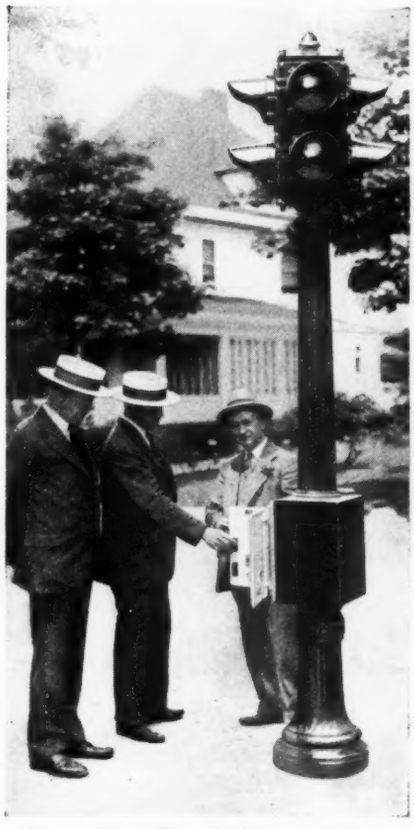
The purpose of the master scale is to standardize heavy weighing in the United States. Other railroads will send test cars to be weighed on the master scale. The cars will be reweighed on their own scales and the results compared. Thus a common standard will govern the 1,200 scales now in use on railroads.

Army Pigeons to Whistle

WHISTLES will be tied to the tails of U. S. Army carrier pigeons to protect them from hawks as a result of experiments at the Signal School, Fort Monmouth, N. J.

Made of featherweight bamboo, the whistles emit a shrill note as the wind passes through them. They resemble those used in the Chinese sport of releasing flocks of pigeons with whistles of different pitches.

The Signal Corps maintains sixteen lofts of carrier pigeons. During the war, the combatants used more than 500,000 of the birds to carry messages.



New Traffic Lights Allow a Three-Mile Run

WHEN this unit in a new traffic signal system installed on Ocean Avenue, Brooklyn, N. Y., says "go," you can run for three miles through city traffic without having the lights turn against you. This is made possible by an electrical control system of synchronizing twenty-one signals so that if a driver maintains an even pace of twenty-two miles an hour, he will never encounter a red stop light. If he drives faster or slower, he will be held up. The new system eliminates forty-two traffic officers.

Thousand-Ton Bridge Moved Eleven Miles on Boats

A THOUSAND-TON, three-section bridge recently was moved down the Weser River, in Germany, from its position near Bremen to a point eleven miles away, where it was re-erected.

Each section, 100 feet long, was mounted on two barges, which had been lowered with water ballast until they were able to move under the span. Then the water was pumped from them and they rose, lifting the section from its piers.

Two tugs towed the barges while a third at the rear held them from ramming the banks on the turns.

The Three Riskiest Jobs

THE three most hazardous jobs in America are those of the steel worker, the railroad yard worker, and the miner, reports the Bureau of Labor Statistics. Other hazardous occupations are glass blowing, slaughtering, and meat packing, and work in lumber planing mills.

During the last year the number of accidents were reduced in almost every industry. However, one worker in sixteen suffered injury, losing an average time of seventy-one days. For every fatal accident there were 155 minor ones. The total time lost during the year due to accidents was more than 19,265 years.

Canada Saving the Bison

CANADA now has more than 13,000 bison on government reservations. The largest herd, about 6,000, is located at Wood Buffalo Park, near Fort Smith, Northwest Territories. The second largest is at Wainwright, Alberta. It grew from four calves adopted by a half-breed, named Michael Pablo, after a slaughter of the animals in Montana. In 1907 he sold the herd, which had increased to 700, to the Canadian government.

Model Locomotive Hauls Real Passengers

A MODEL steam locomotive which can pull its engineer, conductor, and three or four adult passengers along its miniature tracks has been perfected by a young machinist in Vienna, Austria. Its maker claims it is the smallest locomotive in the world that can develop such power. The engine is perfect in every detail and is said to be capable of hauling a load of nearly a ton at a speed of eight miles an hour. It is said to be able to climb a grade of twenty percent.

A sight-seeing trip on a model railway. This little steam locomotive, built by an Austrian machinist, is so powerful that it can haul a load of nearly a ton. It travels at the speed of eight miles an hour.

Schoolboys Build World's Biggest Kite

WHAT is said to be the largest single-surface kite in the world recently was made by small boys in a military academy in Los Angeles, and successfully flown. Five of the youngsters, ranging in age from twelve to sixteen, built the kite. But it took two dozen of them to hold it down once they got it up into the air.

The monster kite can lift a full grown man. It measures more than thirty feet from tip to tip.

Sugar Cane 28 Feet Tall

SUGAR cane that, planted outside your house, would brush against your second-story windows, has just been discovered by American explorers in New Guinea. In the wilds where Prof. Jeswiet, leader of the expedition, found it, the stalks grow twenty-eight feet high.

Italian Airport Has First Two-Story Hangars

THE world's first two-story airplane hangars form part of the equipment of the Littorio Airport, at Rome, Italy, the southern terminal of the Vienna-Rome passenger planes. The machines taxi up to the second story on the 200-foot approach seen in the foreground of the picture below. Accommodations for pilots and passengers are provided on the ground floor.

The building at the right, surmounted by the airport control tower, is a factory where light planes are built.

New High-Pressure Boiler

STEAM at the terrific pressure of 3,375 pounds to the square inch—four or five times as much as the highest steam pressure commonly used in factories—is produced in a new power plant at Charlottenburg, Germany. It is the first large-scale embodiment of the plans conceived by a British engineer named Benson.

High octagonal towers standing in the open air serve as boilers, and their hollow interiors are lined with water tubes where the steam is generated. Coal dust, fed by machinery, burns to give an unprecedentedly hot fire; while the air that fans it is preheated to a scorching temperature of 700 degrees F. before it enters.

"Fighting Jaw" Exploded

THE belief that a protruding jaw indicates pugnacity is scientifically false, according to Dr. Fred Fletcher, American dental expert. "The man with a squirrel-like jaw", he says, "may be dynamite compared to one with a jaw like a mastodon."

Ocean Waterspouts Are Not Salty, Experts Find

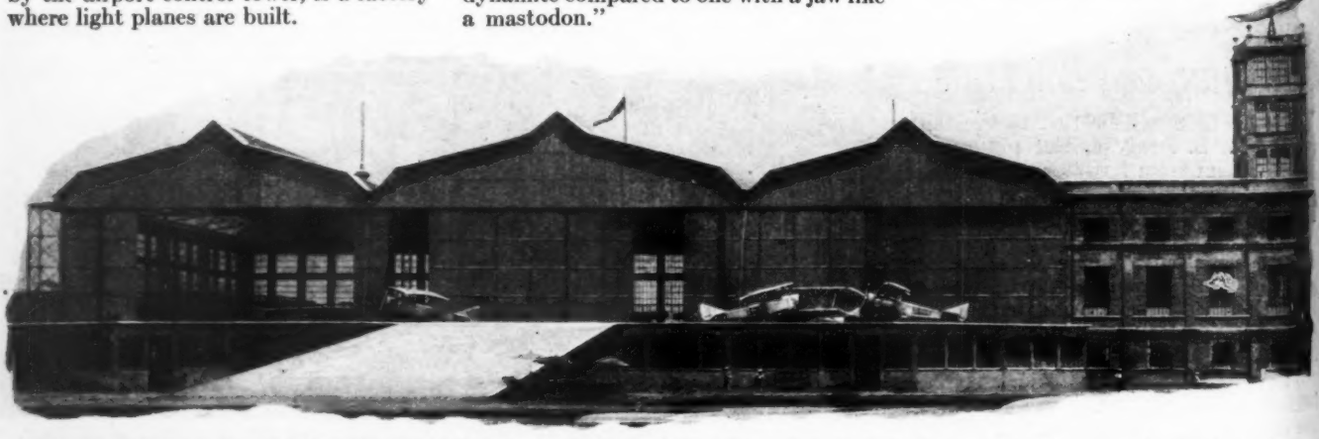
WHERE does the water in a waterspout come from? Meteorologists say the old idea that it is sucked up from the sea is wrong. Over bodies of salt water, the water in these spectacular whirlwinds has been found to be fresh. It is believed that the condensed vapor of the atmosphere through which the whirling vortex moves supplies this.

Waterspouts take two forms. One has a funnel-shaped vortex. The other, illustrated in the photograph below, taken at sea, is known as the dumb-bell type. It has a long, thin tube, whirling at tremendous speed and spreading wider at each end. Spouts of this type have been known to reach nearly four thousand feet into the air.

A giant waterspout over the sea. The whirl contains fresh water, condensed from the air.

Fish and Wood Run Motors

FISH oils, wood tar, and other similar products other than crude oil supply one third of all the "gasoline" used in the world today, according to a recent statement of Dr. Gustav Egloff, of Chicago, research director of a large oil company.



The world's first two-story airplane hangars at the Littorio Airport, Rome, Italy. Planes climb the inclined runway in the foreground to reach the sheds.

More U. S. Fire Tests Set Standards for Safes

SPECTACULAR fire tests to determine the flame resisting qualities of office safes are being continued by the U. S. Bureau of Standards, at Washington, D. C. A few weeks ago, as told in a recent issue of POPULAR SCIENCE MONTHLY, experts of the Bureau set fire to two condemned buildings in which they had placed three dozen safes and filing cabinets. All were subjected to terrific temperatures, as high as 3,500 degrees F.

In more recent experiments, the Bureau uses a special heating chamber. All safes accepted for Government use must pass a threefold ordeal, consisting of half an hour of intense heat, followed by a thirty-foot drop upon a hard surface, and finally another half hour of heat.

N. D. Mitchell, of the U. S. Bureau of Standards, placing a safe in the heat test chamber.

High School Boys Assemble Their Own Airplane

STUDENTS of the North Attleboro, Mass., High School have just assembled their own De Havilland plane as the first step in a new course in aviation. The Liberty-motored machine will be used for ground instruction only; pupils will "taxi" it across the ground and take it apart and reassemble it.

Parts of the De Havilland plane arrive on motor trucks at the high school, to be assembled by students.

Rockets Drive Model Cars and Planes

MODEL automobiles and airplanes, propelled by little rockets, form the latest toy craze in Germany. In this picture, a group of German children are watching one of the toy rocket cars get away for a flying start.

It is patterned after the famous Opel machine, described in a previous issue of POPULAR SCIENCE MONTHLY, which recently attained a speed of 156 miles an hour on rails, without a passenger, before it leaped from the track and was blown to bits by the exploding rockets.

Chemists to Cure Cancer?

THAT hope for a cancer cure may lie in the hands of the chemist is a possibility seen in a new theory of the disease's cause, recently outlined by Dr. Ellice McDonald, of the University of Pennsylvania.

Germs do not cause cancer, according to Dr. McDonald's unusual theory; instead, he claims, the cause may be and probably is excessive alkalinity of the blood. It is this condition, he says, the opposite of "acidosis," that fosters the change of normal human cells into the tumorous growths of cancer.

Radium and X-ray treatments for cancer are of value, Dr. McDonald concludes from his experiments, simply because in some way not yet explained they actually increase the blood's acidity to keep the body cells normal. Eventually this investigator foresees a cancer cure in the discovery of a chemical that will not only neutralize excess alkali in the human body but prevent its formation.

Ants Help Trace Ore Veins

NOW the humble ant comes to the aid of the prospector. How geologists may well pause in their surveying to test ant hills for desired minerals is described in a remarkable report of W. D. Johnston, Jr., of the U. S. Geological Survey, who tells of a recent attempt to map a valuable vein containing iron and manganese ore in the Little Florida Mountains near Deming, New Mexico.

Several test pits had disclosed the vein, but its course lay concealed. As a last resort Johnston examined ant hills in the vicinity and tested the sand of which they were built. One hill proved to contain as much as twenty-two percent of the desired ores—and beneath it lay the hidden vein!

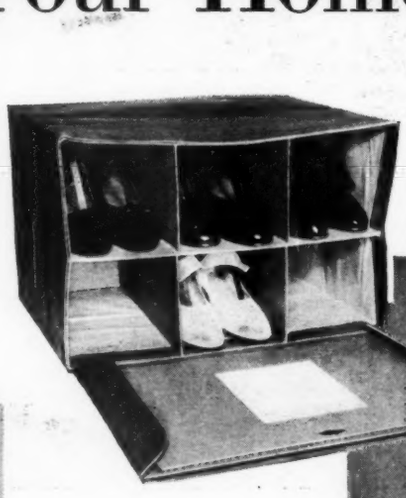
No More "Sea Serpents"

RECENT reports of a strange sea monster washed ashore on a San Salvador beach, said to suggest the possibility that it was a survivor of prehistoric reptiles known as ichthyosaurs, are discounted by Dr. J. W. Gidley, paleontologist of the Smithsonian Institution. A native hunter, he pointed out, might conceivably mistake for such a monster the partially destroyed remains of a dead porpoise or killer whale which had strayed into these waters.

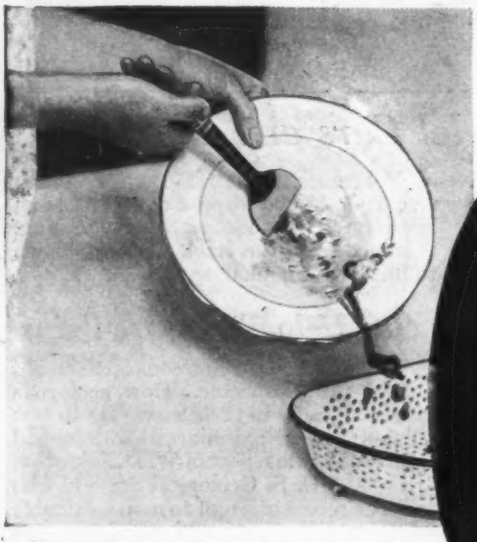
Modern ships have done much to destroy sea serpent fables, says another Smithsonian scientist, Austin H. Clark. Without the imagination-exciting stimulus of a hazardous voyage in a tiny vessel, the sea passenger of today rarely reports such an apparition. Such "sea serpents" as are reported today in good faith, Clark declares, are undoubtedly giant squids or other well-known marine creatures. The squid, often fifty feet long and a foot thick, has branching arms that might easily be taken for sea snakes.

To Make Your Home Complete

A Baker's Dozen of the New Ideas Which Turn Drudgery into Pleasure and Add a Bit to Your Comfort

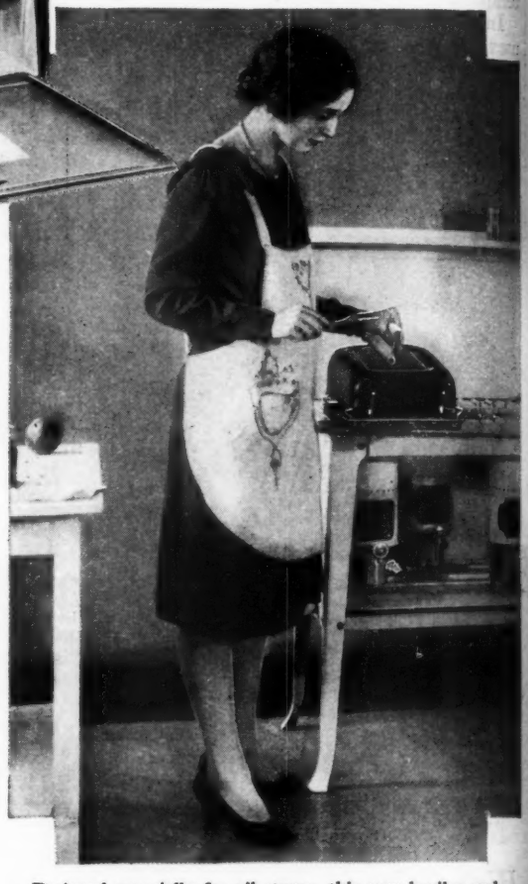


Scrambled shoes need no longer clutter up the closet if you have the folding dust-proof shoe chest shown at the left. It is made of stiff paper. Each of its six compartments will hold a pair of shoes or pumps.



The unpleasant chore of scraping soiled dishes is relieved of much of its disagreeable clatter by this handy scraping tool. Made of a single piece of rubber, it is easy to keep clean, yet is stiff enough not to bend in use.

It's no trick at all to pull an egg out of boiling water with these tongs, whose metal fingers close about the egg and lift it out.



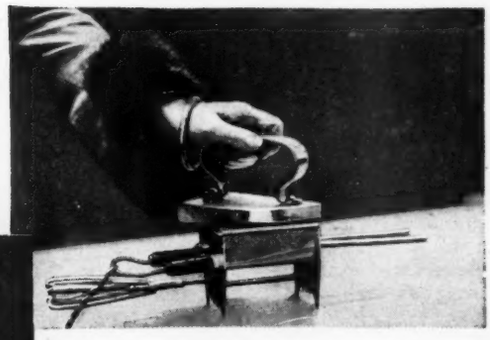
Designed especially for oil stoves, this new broiler and baker is provided with a high, rounded top which gathers heat from the burner and directs it downward upon the meat on the grill inside. Thus, turning the meat is unnecessary. The baker fits over the burner grate.

Cooking in parchment is the latest idea for preserving the delicate natural flavors of food. Meat or vegetables to be cooked are placed in a parchment bag, which is tied at the opening and inserted in the pot or pan.

An ironing board cover can't wrinkle, tear, or slip off if held in place by two sets of these spring clamps. Their metal teeth draw the cloth smooth and tight.

The rubber force cup, that indispensable tool for clearing clogged pipes, becomes doubly powerful with the addition of a hose that connects with the faucet. With the aid of water pressure, stoppages in a drain are quickly remedied. It is necessary only to hold the cup over the drain and turn on the water.

Why use so many kinds of electric heating devices when one can be made to serve all purposes? That was the thought of the French inventor who devised the convertible heater, shown at the right as an ironing stove and below as a combination toaster and food warmer.

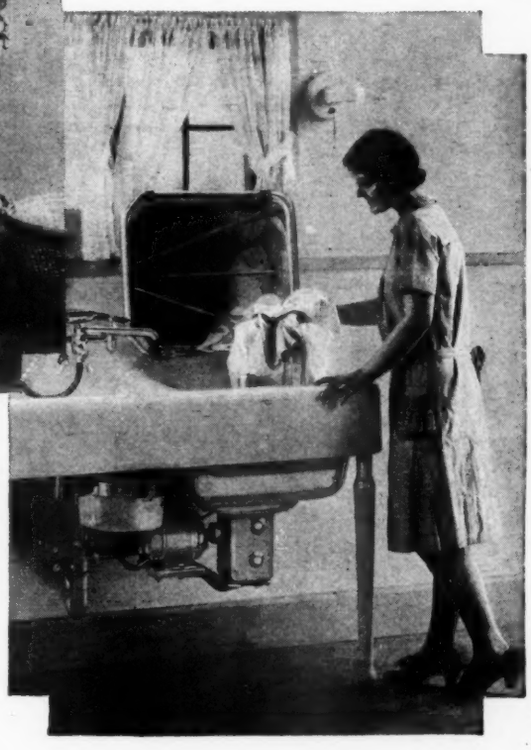


When used on the table for making toast and keeping food warm, as above, the new heater stands upon collapsible legs. For other purposes, such as ironing, the stand is folded up and the heater placed upon its side.

This novel curved brush, of "corkscrew" shape, is designed to clean usually inaccessible parts of milk bottles and fruit jars. It can even squirm into catsup and beverage bottles with small necks.

Distribution of warmth by circulation instead of radiation is claimed for this unusual electric heater. Consisting of a honeycomb type radiator, three percolator units, and a standard fan, it operates to draw in cold air, warm it, and send it circulating through a room or office. It is easily portable and may be used for auxiliary heating.

There used to be no telling where a fish or pancake would land when you flipped it over. But this double turner has spring jaws which open at a touch of the thumb to grasp the fish.



This combination kitchen sink and electric clothes washer for light laundering is the latest innovation for the home or apartment. It is intended especially to wash clothing which is needed immediately or which might be ruined in the regular laundry, such as luncheon sets, children's garments, silk sweaters, and underthings. The equipment includes a wringer which is quickly attached to the sink, as shown above. When the washer is not in use, the wringer is removed, and the metal cover of the machine closes down to form a drainboard for the sink compartment. At right: the washer in use.

Handy new wedges, obtainable in a package of six, take the wabble out of unsteady tables or chairs. One or two blocks are used under the offending short leg. Each is bored for hanging up before use.

Automobile Engine Drives Power Hoist

Driven from an auto rear wheel, and controlled by a single lever, this hoist can lift 600 pounds.

AN INGENIOUS automobile-driven hoist, designed for small lifting jobs, can be attached to the rear wheel of a motor car or truck in five minutes, according to the maker, and will lift weights of 600 pounds as high as twenty-four stories. A single lever controls it and, should the motor stop with the load in mid-air, the mechanism is designed to lower the load gradually to the ground.

The entire outfit weighs only eighty-eight pounds complete. It is intended to save the time and energy of plasterers, roofers, and contractors on construction jobs where hoisting of comparatively light materials is required.

Fawcett Slain by Indians

COL. P. H. FAWCETT, British explorer, whose disappearance in the Brazilian jungle has for three years been an unsolved mystery, probably died at the hands of hostile Indians. That is the conclusion of Commander George M. Dyott, head of a search expedition, expressed in a radio flash from out of the jungle that has just reached the world after being twice relayed.

Commander Dyott, whose expedition was described recently in POPULAR SCIENCE MONTHLY, reported that his men had successfully followed Fawcett's trail, and that Indian guides who knew the lost man's fate were unable to lead the search to the spot where his party's remains were buried only by reason of unfriendly tribes who blocked the way.

Discovers Alaskan Volcano

THE United States is the possessor of another volcano in Alaska, just discovered by the Pavlov Volcano Expedition headed by the American expert, Dr. T. A. Jaggar. He reports that the mountain is north of Canoe Bay and is 4,300 feet high. A small lake lies in its crater.

Dr. Jaggar also has reported that the ingenious amphibious auto-boat which his expedition carries has proved a decided success. Running on either land or water it has done valiant service in hauling supplies and passengers, in trolling for fish, and in transporting to camp game shot in the foothills.

Thirty Billion Cups of Tea

IT WOULD take twenty-five average steamships, loaded to capacity, to carry all the tea used in the United States in one year. Fifty million people each year drink 30,000,000,000 cups of tea, costing seventy-five million dollars.

Know Your Car

THE most disconcerting thing that can happen on the road is for the motor suddenly to cease firing, as though the ignition switch were thrown off.

However, the manner in which the motor goes dead is a definite symptom that will help you locate the trouble. If it stops suddenly without producing any peculiar sounds, then the trouble cannot be in the carburetor; for almost any kind of carburetor trouble, including running out of gas, causes irregular running just before the motor stops. Likewise, no failure of the oiling system or the water cooling units could be to blame, and a stuck valve or mechanical trouble would be accompanied by whistling or sucking noises, or a tremendous clanking.

The ignition system is almost surely at fault and the three most likely troubles are broken wire or connection, blown condenser, and short-circuited spark coil, in the order named.

Value in Waste from Gas

BY-PRODUCTS of illuminating gas manufacture, which now serve only to gum up the meter in your cellar, soon may be turned to use in making plastics and perfumes worth many thousands of dollars a year. Investigating the clogging of meters, experts in the organic chemical laboratory of the U. S. Bureau of Mines have discovered that the trouble is due to gum formation from the chemical compounds, indene and styrene, always present in manufactured gas.

If completely separated from the gas, eight million pounds of styrene and twice that amount of indene would be available annually for making plastics and perfumes, and possibly in rubber making.

Radio Pictures Received on Cylinder Records

PICTURES sent by radio are played like phonograph records in a system of photo transmission and reception, invented by Capt. O. Fulton, and recently demonstrated in London, England. Both transmitting and receiving instruments employ revolving cylinders, not unlike the records of an old-fashioned phonograph.

The photograph to be transmitted is placed on a cylinder where, revolving, it is scanned by a beam of light. Patches of light and shadow which make up the picture are translated by a photo-electric cell into corresponding electric impulses of varying intensity. These impulses, transmitted by radio and picked up by the receiving instrument, actuate a recording device which translates them back into patches of light and shadow on a cylinder record, thus building up a half-tone reproduction of the original.

This process closely resembles the method used in sending the first radio pictures across the Atlantic.

The inventor demonstrates his system of sending pictures by radio. The receiving set, shown here, contains a cylindrical record on which radio impulses are translated into half-tone reproductions.

Know Your World

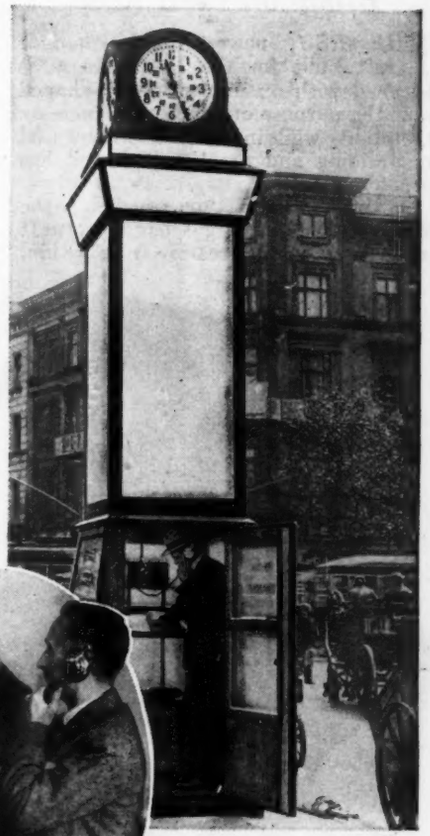
TO TEST your knowledge of the world you live in, see how many of these questions you can answer. Correct answers appear on page 156.

1. **What is the world's largest island?**
2. **Where can natural rock salt be seen in the United States?**
3. **What is the driest place in the world?**
4. **What male bird hatches eggs?**
5. **What worm is called the "honorable little gentleman?"**
6. **Where do sheep have little carts on which to haul their tails?**
7. **Where did Columbus first land on the American continent?**
8. **What part of the world has the most sunshine?**
9. **To what race do the creoles belong?**
10. **What city loses two hours of daylight each day?**
11. **What is a Gila monster?**
12. **What produced the stone trees of the Petrified Forest?**

Berlin Clocks Hold Telephone Booths

TWO advances in the telephone service of Berlin, Germany, have resulted from the perfection of automatic instruments. For the first time, long distance calls can be made automatically from a pay station by the dial method without having to call central first. The telephone box has four slots to receive coins of as many different denominations, the amount deposited being recorded automatically in the central exchange.

Another innovation is the placing of automatic phones in booths built into the street clocks, which have been established by the Berlin Astronomical Observatory in different parts of the city.



Above: Putting in a call at one of the automatic phone booths built into the street clocks in Berlin. Left: The new automatic long distance telephone. Calls are made by inserting coins and "dialing."

Invents Railless Trains

A RAILLESS steam locomotive, designed to haul trains over the solid stone roads of his native land, has been invented by Ahmed Nassery Shahpar, a Persian studying railroading in the United States. The locomotive resembles a tractor in construction and is said to be able to pull ten passenger cars, each loaded with forty people, at a fair rate of speed.

Messages Decoded Automatically

ELECTRIC typewriting machines which automatically translate messages into secret code or decode them, as fast as a typist can write the messages, are the recent invention of Alexander von Kryha, of Berlin, Germany. The invention consists of three units—two typewriters and a central control box, all connected by a system of electric relays. As the operator taps the keys of the first typewriter, each key, in addition to printing a letter, sends an electric impulse to the control box. From there the impulses are relayed to the various keys of the second typewriter, which prints the message in code.

On the panel of the central box, a dial which controls a series of switches has the various letters of the alphabet printed around its outer edge, and on the panel opposite the letters are the letters to be used in the code. When a certain letter of the alphabet is struck on the first typewriter, the second typewriter will receive an impulse to print whatever letter is opposite on the controlling dial. Thus, by turning the dial to vary the arrangement of opposing letters, the code used may be changed at the will of the operator.

By reversing the process, secret messages may be decoded if the setting of the control dial used by the sender is known. It is necessary only to typewrite the code message, which will be translated by the second machine.

As the typist writes a message, this electric apparatus automatically translates it into secret code which is typewritten by the machine at right. The latter is governed by the central instrument.

Does Gulf Stream Reverse?

THAT the Gulf Stream—the warm current flowing eastward across the North Atlantic—turns around in the middle of the ocean and starts back toward America is the surprising phenomenon recently reported by the captains of two large trans-Atlantic ships.

This announcement led to the suggestion that the climate of England might grow colder, but scientific authorities say that the current's reversal is a local irregularity, and that there is no danger of the Ice Age returning to Britain.

A Diesel Motor for Trucks

A NEW lightweight, high-speed Diesel motor, burning a cheap grade of heavy fuel oil, is reported to have been perfected by a German manufacturer for use especially in motor trucks, buses, and railway motor cars. It may also be employed extensively as a stationary power unit—operating pumps and hoisting machinery and generating electric current.

Danger of burning out bearings, due to the high speed of rotation, is said to be eliminated by a new oiling system.

Heart Shape Keeps New U. S. Blimp on Even Keel

THE *RS-1*, newest lighter-than-air craft built for the U. S. Army, is designed with an unusual heart-shaped bow, the purpose of which is to increase its stability while in flight. It will be used for training and practice flights, it has been announced.

In this semirigid type of airship the keel is rigid but the gas bag is not. It keeps its shape by pressure from within.

The Army's new semirigid airship, *RS-1*, in its hangar at Lakehurst, N. J., ready for trial.

As gas escapes during a flight, "balloonets" inside are filled with air, thus keeping the pressure constant.

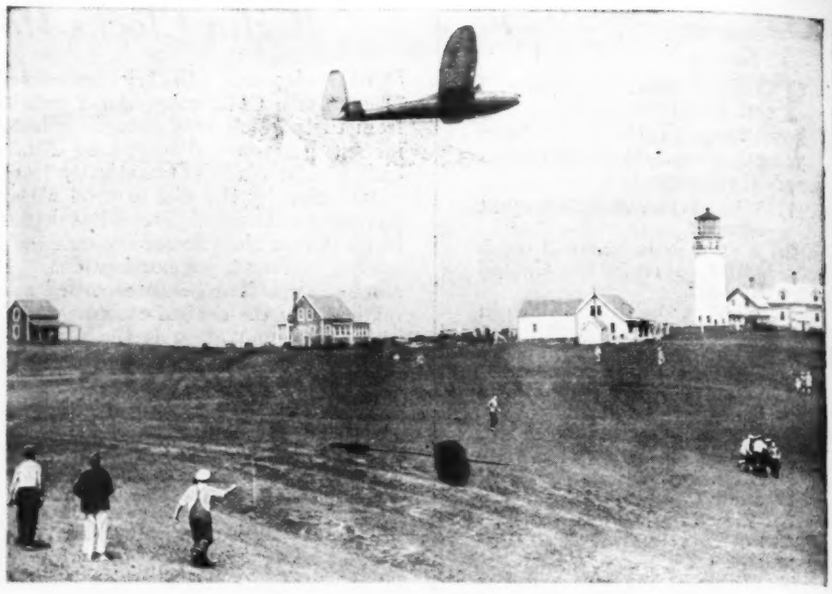
The double-balloon effect at the top of the *RS-1* acts somewhat as pontoons do in the water, reducing pitching of the ship in the wind.

This Mail Plane Has First Aerial Letter Box

LATE air mail can be dropped directly into a letter slot built into the fuselage of a new type mail plane recently put into service on a western air route. United States Senator William E. Borah was one of the first to post a letter in this aerial mail box recently at the air field at Boise, Idaho, just before the pilot started up his engine and took off on a flight to Salt Lake City, Utah.

Want a Name for Platinum

A DISTINGUISHING term for platinum, similar to "Sterling" for silver, is being urged by leading American jewelers to prevent unscrupulous manufacturers selling as pure platinum jewelry containing cheaper metals. The public, they say, cannot tell the difference between pure platinum jewelry and jewelry containing a mixture of platinum and palladium, which costs less. The "quality mark" would be stamped on the jewelry, together with the manufacturer's trade mark.



German Glider Thrills Americans

IN ONE of the first public demonstrations of German gliders in America, Peter Hesselbach, holder of the world's duration record of five hours for motorless flying with a passenger, recently had a thrilling escape from death at the edge of a high cliff near Highland Light, Cape Cod, Mass. By inches, his machine missed plunging over the bluff.

Hesselbach was piloting the 300-pound German glider *Darmstadt*. Pulled by an untrained ground crew, the craft failed to gain altitude. When, at the last minute, Hesselbach blew the whistle that signaled them to release the rubber launching rope, the craft settled and slid along the ground until its nose overhung a 140-foot drop to the ocean's edge. In another flight Hesselbach remained aloft for four hours and five minutes, soaring about 120 miles. The picture above shows the start of the flight.

The Cape Cod region, according to the pilot, offers better possibilities for soaring flight than many of the best spots in Germany. As was told in an article in the August POPULAR SCIENCE MONTHLY, Hesselbach with two companions, Capt. Paul Roehre and Dr. Paul Laubenthal, came to America under the auspices of the American Motorless Aviation Club to help popularize the sport of gliding by a series of demonstrations. Before their arrival, the American duration record for gliders of nine minutes and forty-nine seconds, established by Orville Wright in 1911, stood unchallenged, although glider flights up to fourteen hours had been made in Germany.

United States Senator W. E. Borah posts a letter in mail plane box at Boise, Idaho.

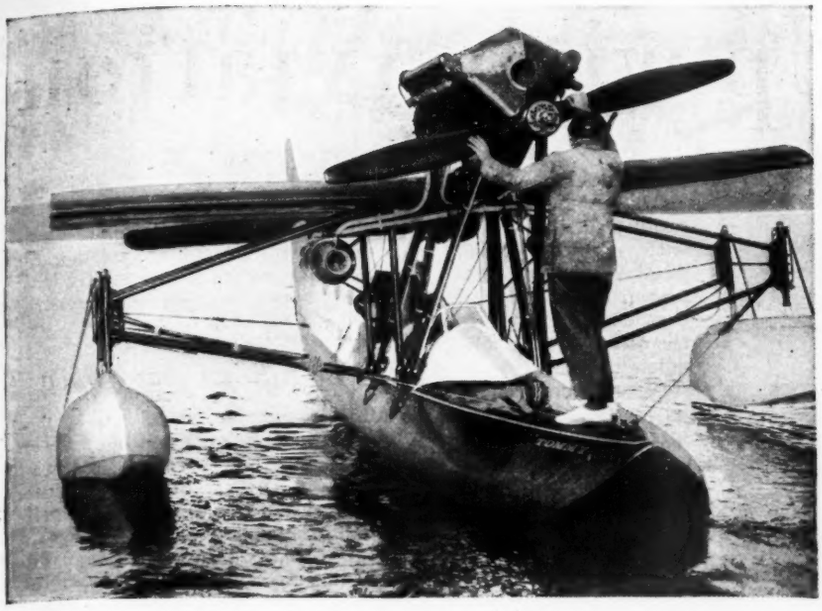
Saves Vast Ore Deposits

MILLIONS of tons of Wisconsin iron ore, in mines abandoned because of its high sulphur content, will be saved by a new smelting process developed by Prof. Richard S. McCaffery, University of Wisconsin metallurgist. In some mines the ore showed four times the amount of sulphur found in the output of successful mines. In the Mayville region of Dodge County, a $5,000,000 smelting plant closed down because of this inferiority.

In the new process a combination of limestone and coke is added during smelting. Lime, combining with the sand and clay in the iron ore, produces a slag of silica, alumina, lime, and magnesia, which dissolves the sulphur and removes it from the ore.

Propose Larger Golf Ball

TO MAKE the game more difficult, the British Golf Ball Committee has proposed the adoption of a new ball, slightly larger and lighter than those now used. It would cut down the length of drives. Golf authorities claim that while the proposed ball would have little effect on the game of professionals and champions, ordinary players would find their scores mounting.



New Sea Flea *Hops 80 Miles an Hour*

A WINGED motor boat, called the *Sea Flea* by its inventor, George de Gasenko, Ukrainian engineer, made its appearance two years ago and was described in the pages of POPULAR SCIENCE MONTHLY. A new model of the invention has just been put through tests on Lake Teplin, near Berlin, Germany. It skims over the water in long jumps at tremendous speed. The designer expects it to lead to larger machines that will hop over the surface of the ocean like flying fish, carrying thirty passengers across the Atlantic in less than forty hours, even through winter storms.

The first model of the invention, with tiny, nine-foot wings, began lifting the boat in sixty-five-foot hops at a speed of thirty-six miles an hour. It is reported to have traveled most of the way across the Mediterranean from Marseilles, France, at nearly a mile a minute.

Above is the latest experimental machine, equipped with larger lifting surfaces. During recent speed trials, it is said by its designer to have been clocked at eighty miles an hour.

Champion Globe Circlers Set 23-Day Record

THE world shrank nearly a fifth its size, as far as time required to travel around it is concerned, the other day when John Henry Mears and Charles C. B. D. Collyer, with "Tail Wind," their white terrier mascot, landed at Miller Field, Staten Island, N. Y., in their folding wing Fairchild monoplane, the *City of New York*.

They had girdled the globe by plane and steamboat in the record time of twenty-three days, fifteen hours, twenty-one minutes and sixteen seconds. This cuts nearly five days from the previous record for the 25,000-mile trip made in 1926 by Linton Wells and E. S. Evans.

Mears (left) and Collyer (right) welcomed by Lieut. Col. Henry W. Fleet at Miller Field.

Reliefs for the Seasick

TWO new methods of combating seasickness recently have been brought to the aid of travelers who suffer on ocean voyages. One is the invention of "antiseasickness tanks," installed on the larger steamers of the Hamburg-American line. These are in the form of great blisters along the water line of the ship. Sea water, rushing into these tanks through portholes, adjusts the ballast automatically and reduces the ship's roll.

The other is a method of treating seasickness discovered by an English physician, Dr. R. A. Bennett. It consists of a salt water bath at a temperature of about ninety degrees, to be taken when waves of sickness begin to be felt. The patient is instructed to lie in the water with his eyes blindfolded. While the bathtub moves with the ship, the water in the tub responds to the motion only slightly, so that the immersed patient remains fairly motionless. The blindfold serves to shut out sense of motion.

Six Heads on One Cabbage

THE latest wonder of agricultural experiment is a cabbage plant which produced six heads of cabbage in turn, one above the other. It was grown by Julian C. Miller, of Cornell University, who obtained the remarkable results by keeping the plant at high temperatures over a period of two years.

"Flivver" Airplane Motor Weighs Only 60 Pounds

AS STRONG as twenty horses, yet so light that a girl can lift it, a midget airplane motor just produced by an aircraft manufacturer in Sacramento, Calif., is said to be the smallest in the world. It is a four-cylinder air-cooled radial engine weighing only sixty pounds with propeller. In tests it drove a "flivver" plane ninety miles an hour.

Even a girl can lift it, yet this tiny airplane motor, air-cooled, develops twenty horsepower.

Test Striped Street Light

STREET lamps which shed striped light rather than a uniform glow are ideal for making pedestrians visible to motorists. This surprising fact was revealed in tests made by the Association of Lighting Engineers in England.

In uniform strong light, it was found, an auto driver sees a pedestrian or other object mostly by the contrast in brightness between that object and the darker background. In weak light he sees them mostly by the shadows they cast.

In one test with weak light from lamps which cast no shadows on the road, pedestrians could not be seen at all. But when this same light was altered to cast bands of light and dark, the pedestrians instantly became visible.

Experts express doubt, however, that striped light can be used effectively for road illumination, since it may hide pitfalls in the road itself.

Birds Carry Periscopes

WITHIN the eyes of ground birds are tiny periscopes, reflectors which enable them to observe the approach of enemies from behind, says Prof. Arthur Thomson, of Oxford University, England.

Keeping Up with Aviation

The *City of Glendale*, first all-metal, steam-powered airship, is seen here being moved from the Glendale, Calif., hangar where it was built. The strange craft, designed by Capt. Thomas B. Slate, is 200 ft. long and has a shell of duralumin. It has seven steam turbines, but no propellers. Instead, a blower at the nose, says Slate, will create a partial vacuum, pulling the ship at 80 miles an hour.

PRACTICAL development of the radio beacon for aircraft, achieved only this year, is to be followed by its extensive installation on commercial air routes in the United States by 1930, according to the U. S. Bureau of Standards. Through its use, pilots for the first time will be freed of fog's menace, for no longer will they be obliged to fly blind. Radio signals tell them instantly if they are off their course.

As long ago as 1920 the War Department asked the U. S. Bureau of Standards to develop a system of directing aircraft by radio. First of the methods used was the scheme of broadcasting radio beams of equal intensity pointed at different angles, from two stations. An airman could fly an approximately straight course by following a path along which the signals from the two stations sounded equally strong.

With the improved system the Bureau of Standards incorporated a visual indicator on the pilot's instrument board. In the present outfit, a plane need carry only a short pole antenna and a receiver weighing but a few pounds. All of the powerful and expensive equipment is on the ground. Two white lines on a black instrument dial shrink or extend unequally before the pilot's eyes to show him whether he is flying to left or right of his course. When they are equal, he is directly on it.

Silent Planes Invisible

UNSEEN planes that make no noise may wreak havoc upon cities with their bombs in the event of future wars. This startling prophecy, made by a British aeronautical expert, is based on his declaration that already England, France, Germany, and Russia have nearly realized such a "ghost plane."

Some time ago, the French aviation service was reported to be developing an invisible, silent airplane with muffled engine. Today, says this expert, it has been found that the propellers themselves may be quieted by the use of small air screws with six or more blades of special shape.

British experimenters have developed an airplane "dope" or paint of dull greenish tint said to make a machine flying at moderate altitude practically invisible against the sky, either by daylight or in the glare of a searchlight, at night. In Germany, tests are being conducted to devise a type of camouflage to be employed for the under surfaces of a plane's wings, intended to breakup tell-tale shadows and thus to disguise the wings' true shape and size.

Two Cross-Country Records

FLYING across the continent from Los Angeles to New York in eighteen hours and fifty-eight minutes, Col. Arthur Goebel, 1927 winner of the Dole race across the Pacific to Honolulu, recently added two more records at once to his collection of laurels. He had made the first nonstop flight from west to east across the United States; and the fastest trip ever made either way.

Macready and Kelly, Army aviators who in 1923 made the only other nonstop cross country flight on record, took twenty-seven hours to fly from New York to San Diego. Goebel not only shattered this record, but clipped three hours from the one-stop, "dawn-to-dusk" flight made by Lt. R. L. Maughan, of the Army, in 1924.

Tons of Air Mail

NINE tons of air mail left Lansing, Mich., in a single shipment the other day. Eighteen Stinson-Detroiter planes carried their weighty consignment of 350,000 circulars announcing a new model automobile, to Chicago, where the leaflets were sorted and sped by air to all parts of the country.

Other firms hastening to take advantage of the new lowered air mail postage rate already have helped boost the volume of air mail nearly fifty percent, according to post office officials; and Irving W. Glover, Second Assistant Postmaster-General, foresees another similar increase in the coming six months. Air lines carrying mail on contract have repeatedly been obliged to fly extra sections.

He Couldn't Come Down

FOR two minutes, it looked as if a parachute jumper at Brooks Field, Texas, was doomed to remain in the air indefinitely. He had the recent novel experience, according to the War Department, of jumping from a plane into a powerful rising wind current that suspended him practically motionless at an altitude of 2,000 feet above the earth.

It was his first parachute jump and he was wondering what he should do next in order to come down, when the updraft slackened and he gradually descended to earth at the record speed of three feet a second.

Link Air, Earth, and Sea

EVEN before the first air-rail line in this country went into operation in September, extending rail service by air between Chicago and the twin cities of Minneapolis and St. Paul, another part of the country saw an actual air-rail passenger transfer. Passing Smithboro, Ill., Guy Hickman, engineer of the Pennsylvania Railroad's Gotham Limited, observed a large passenger plane flying low along the tracks, its occupants waving. At the next train stop, Effingham, Ill., the plane awaited the train with two

This is the newest of British fast fighting planes, the Hawker *Hawfinch* biplane, winner in recent trials to select machines for the Home Defense Squadron of the Royal Air Force, to be centered near London. In speed tests, pilots of this squadron got into their togs and rose 10,000 feet in the air in fighting formation—all in seven minutes.

New Radio Beacons to Safeguard U. S. Airways; Unusual Planes and Remarkable Flying Records

women passengers for New York. They had come by air from Tulsa, Okla., to catch it and had flown low to identify the train as the one they wished to board.

Elsewhere air facilities have been linked to advantage with other modes of travel. Germany has just effected an elaborate hook-up between its entire air and railway systems for the speedy transportation of freight. Five-hundred-mile ship-to-shore flights inaugurated by the French Line steamer *Ile de France* are saving twenty hours in delivery of mail at New York and at Cherbourg, France. Additional planes are to be provided for longer, 800-mile flights and will carry passengers. Other steamship lines are contemplating similar service. During the last five months, Canadian planes have transferred mail by air from incoming steamers at Rimouski, Quebec, at the mouth of the St. Lawrence River, to Toronto, arriving there hours before the boat.

Highest Beacon on Stamp

STAMP collectors who have just placed the new five-cent air mail stamp in their albums, and others who use it, will be interested to know that the design is not an imaginary but an actual scene. Ten thousand feet above sea level, the world's highest air beacon near Cheyenne, Wyo., guides planes of the Boeing line between Chicago and San Francisco; and the picture on the stamp represents this light.

Now Canada, too, announces an air mail stamp. Such air mail postage issues, of countries in all parts of the world, offer a new specialty to those who collect stamps as a hobby. Its enthusiasts have recently formed for their mutual benefit the National Air Mail Society, at Chicago, Ill.

How to Use the Air Mail

FOR those who are still uncertain just how to use the air mail and what advantages it offers, the U. S. Post Office issues the following information:

Letters marked "Air Mail," or stamped with air mail stamps, will be carried to any part of the United States at a usual saving in time of from four hours to two and a half days.

The new air mail rate is five cents for the first ounce and ten cents for every ounce thereafter. No additional postage is required.

Either ordinary stamps or special air mail stamps may be used. If ordinary stamps, the letter should be plainly marked "AIR MAIL." Air mail stamps of various denominations may be obtained at all post offices.

Letters sent via air mail may be posted at any post office, in any regular mail collection box, or in special collection boxes for air mail only. If placed in ordinary mail boxes, the collection time shown on the box should be noted for guidance.

Letters for air mail dispatch should be posted sufficiently early to connect with departing planes. Practically all collection boxes show the latest time in which air mail may be deposited therein. Air mail schedules may be obtained from your local postmaster.

Lettered flags replace smoke in this novel method of sky writing invented by Ernst Udet, German pilot. Here he is writing his name. Huge black letters on white background are visible hundreds of feet below. The letters are lowered through a tube under the ship and reeled in by hand wheel (left).

Air Line Network Grows

OVERNIGHT the mail and passenger network that spans the United States is undergoing mushroom development. This month should see the new air line of the Canadian Colonial Airways, between New York and Montreal, in operation despite delays in securing airports and arrangements for night lighting. Actual survey has begun on the Miami-to-Panama route scheduled to be operated by the Pan-American Airways in January. The long-awaited U. S.-Mexico air mail may be realized any day.

Within the United States, planes of the United States Air Transport already are carrying passengers between New York and Washington in two and a quarter hours, at a fare of $30. Texas is blanketed by the new air lines of the Texas Air Transport, and the state of Michigan by those of the Thompson Aeronautical Corporation. Chicago has new routes to Louisville, Ky., and to Madison, Wis. Before many months, a proposed air line may slice the country from Chicago to Miami, Fla. The eastward section of this line from Atlanta, Georgia, to Miami is already under mail contract, though not yet operating.

Airport Traffic Signals

TRAFFIC signals direct planes landing and taking off at the Oakland, Calif., municipal airport. An airplane control station with a system of signals resembling those of a railroad has been erected on top of the administration building at the airport.

One of the latest developments in commercial planes is the new Curtiss *Robin*, a cabin monoplane. It is capable of carrying 700 pounds of freight or passengers, or a mixed load of both.

Popular Science
MONTHLY

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Published Monthly by Popular Science Publishing Company, Inc., 250 Fourth Avenue, New York City. Single Copies Twenty-five Cents. In the United States and Its Possessions and in Canada, $2.50 the Year. In All Other Countries, $3.00 the Year.

A Problem in Addition

MOST great inventions and scientific achievements are, after all, merely object lessons in adding two and two to make four.

The elementary principles of electromagnetism, for example, were well known to scientists for years. Then along came an artist named Morse who added them all together and got a result in the telegraph that revolutionized human communication.

Years went by. Alexander Graham Bell took Morse's telegraph, tacked on more known ideas, and the world gasped in amazement at the telephone.

Now who will solve another similar problem in scientific addition? Who will produce the really perfect motion picture? Such a picture must be one which makes the observer believe he is seeing the real thing and not a reproduction. It must at once show form, color, sound, and perspective.

Our present motion pictures have form. Expert photography has seen to that. Sound we have, too. Eastman recently has produced motion pictures in color for amateur photographers. Photography in full perspective has been a fact for years. The stereoscope and a packet of views were common objects on the parlor table thirty years ago.

A pretty problem in addition, to sum these known scientific achievements into a homogeneous total—the perfect motion picture. And if you wish to tackle a still harder problem, try to add the theoretical possibilities of television to the sum and produce the perfect motion picture by radio!

When Trifles Count Large

IN AN eighteenth century laboratory, two pieces of metal, attached to a galvanometer, were thrust into a salt solution until they touched the leg of a dead frog. At that moment, the experimenter noticed the galvanometer move. He announced that the source of electrical current was frog's legs. Volta, maker of the first battery, disagreed. He said the action of the solution on the metals produced the electricity.

So, an argument over frog's legs gave us the electrical battery. The accidental splitting of a piece of steel brought the steel pen. A twisted pasteboard box suggested wing-warping and made the airplane possible. A chance meeting in an auto bus gave us new knowledge about twins, as is told in this issue.

"Almost everything comes from almost nothing."

Aviation's Deep Riddle

ATTEMPTING a solo flight in his new airplane, Fred Stone, famous comedian, recently crashed and suffered severe injuries. If Stone were an ordinary actor, the incident might be dismissed as one of those unavoidable mishaps of flying training.

Stone, though, in his own particular way, probably was the most versatile genius that ever lived. He was a dancer, an acrobat, a trained athlete. He could walk a tightrope, ride a bucking broncho, twirl a lariat with the skill of a Will Rogers; he had boxed with champions, played polo with international stars. He was driving an automobile when one garage could have housed all the cars in the United States. He played baseball well enough to have been a big leaguer. He has lassoed Polar bears on the Arctic ice. He was an expert at fancy ice skating, juggling, rifle shooting, and wielding the bull whip.

He was, in short, a marvelous physical specimen—just the sort of man, you would say, who would make an excellent aviator. Yet, after an adequate period of training, he came to grief almost the first time he essayed to fly alone.

Such a happening must cause us to wonder whether aviation enthusiasts are not unduly optimistic in predicting that some day every man will pilot his own airplane. It gives peculiar significance to the article in this issue by Dr. L. H. Bauer, Medical Director of Aeronautics, Department of Commerce, on the physical requirements of pilots.

Are good aviators, after all, a breed apart?

Steam Heat for Nothing

WITHOUT warning, a great new geyser recently roared from the ground in Yellowstone National Park, Wyoming. Today it is spouting steaming water, at fifteen-second intervals, sometimes to a height of 100 feet. Its present output of hot water would form a stream four feet wide and eight inches deep, flowing 120 feet a minute.

In California and in Italy, volcanic steam has been harnessed for industry. Iceland is preparing to pipe boiling water from its famous geysers and hot springs to heat homes in a region where coal and wood are scarce, just as steam is distributed from central heating plants in large American cities.

In Yellowstone Park there are about 100 eruptive geysers and some 3,000 hot springs, all unused. Every so often Nature reminds us, with some magnificent new display, of the wealth stored in the earth. This time, the leaping steam of a second "Hell's Half Acre" advertises enormous underground boilers, worth millions of dollars to men who can put them to work.

They Are Saying—

"THE earth was split off from the sun as a ball of fire of high temperature about 1,600,000,000 years ago."—Dr. A. J. Nernst, University of Berlin.

"Germany needs aerial patrolmen right now, and in a few years all Europe and America will have flying policemen."—Prof. Otto E. Shreiber, Koenigsberg University.

"Neither the new British nor the new German dirigible can be successful commercially."—Capt. Anton Heinen, builder of the *Los Angeles*.

"When we look at a photograph, or at a movie film, we are really crystal gazing, seeing on a square inch of film more crystals of silver bromide than there are human beings on the earth."—Dr. C. E. Kenneth Mees, Eastman Kodak Co.

"Of the 1,177 different kinds of trees found in the United States, 137 have special medicinal virtues."—Prof. Ernest F. Stuhr, Oregon State Agricultural College.

"Employment of scientific knowledge in government ought to come as naturally as the employment of a doctor or a plumber."—Dr. Graham Wallas, British political scientist.

"Five percent of chewing gum is rubber."—Dr. W. L. Semon, noted rubber authority.

"The average unskilled laborer now works four hours a day to pay for food for his family and less than ten minutes for lighting his home."—Dr. M. Lukiesh, National Lamp Works.

"When the need comes, the chemist will convert the light of the sun and the nitrogen of the air into food for the human family."—Dr. H. E. Barnard, Indianapolis.

"With calolinium sulphate, science hopes to get to so-called absolute zero, a frigidity of 459 degrees below zero."—Prof. B. S. Hopkins, University of Illinois.

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*NON-ARTICULATED

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A BIG, hulking monster of the rails—807,000 pounds in weight—102 feet in length—the most powerful non-articulated locomotive ever built.

And, at the other extreme, a veritable pigmy among locomotives that hauls and thrills kiddies at an amusement park.

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For the railroad man, with his keen insight into values and his cold calculating consideration of PERFORMANCE, appreciates, perhaps as no other can, that "Nothing Is Apt To Cost So Much As A Bearing That Cost So Little".

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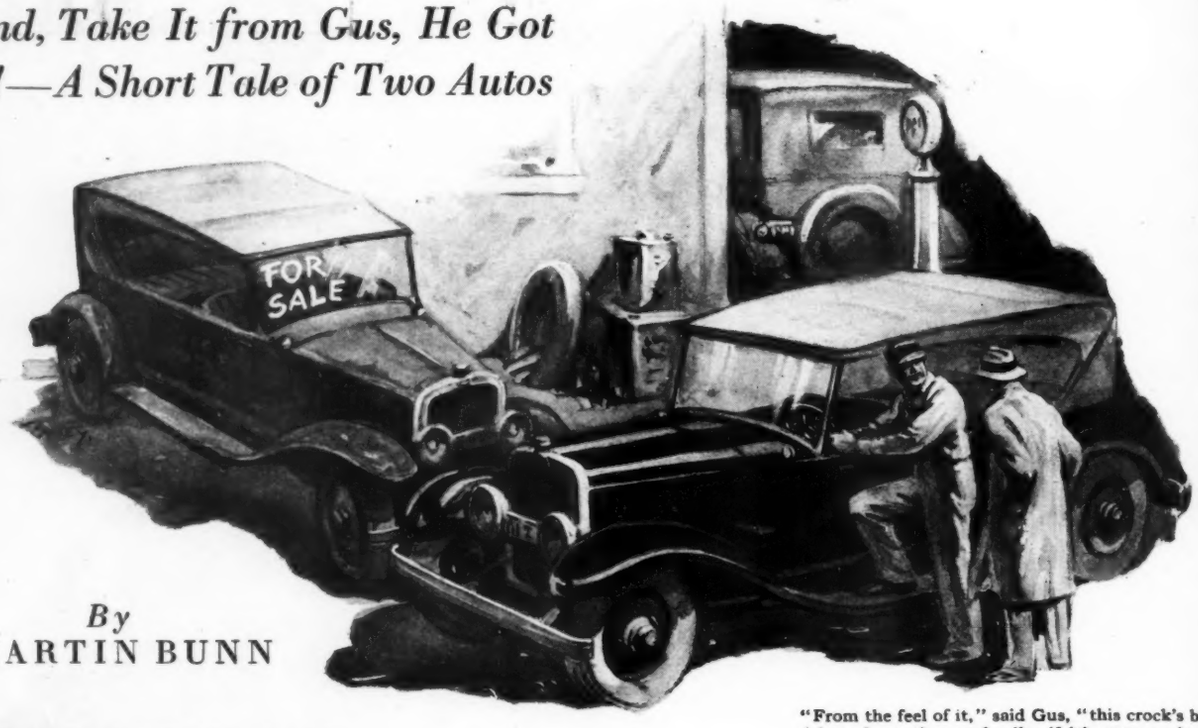
Nothing Is Apt To Cost So Much As A Bearing That Cost So Little

He Wanted a Used Car Bargain

And, Take It from Gus, He Got It!—A Short Tale of Two Autos



"From the feel of it," said Gus, "this crock's been driven forty thousand miles if it's gone an inch."

By
MARTIN BUNN

"I'M a mechanic, not a blooming auto salesman!" Gus Wilson grumbled as Joe Clark, his partner in the Model Garage, finished reading the letter he held in his hand.

"Why be so grouchy?" grinned Joe. "Hamilton was a good customer and we ought to be willing to do something for him. It wasn't his fault he got transferred to San Francisco so suddenly. All he asks us to do is sell his car for the best price we can get and send him what's left over after taking out what he owes us."

"All right," Gus agreed. "Put an advertisement in the paper. We ought to get a couple of hundred more than the current price for a car of that make and year. Mechanically it's practically as good as new. Hamilton always handled it as carefully as a crate of eggs."

Several prospective buyers answered the advertisement, but only one showed real interest. It appeared that he had been looking for a secondhand car of that particular model for some time.

"What gets me," growled the prospect, "is how you have the nerve to ask so much. I've seen other cars that looked just as good that I could have bought for a lot less."

"THIS car's worth more, Mr. Estey, because it's in exceptionally good condition," Gus insisted.

"Aw, rats! That's what they all say!" Estey sneered. "I guess I'll keep on looking." And he walked out.

"Humph!" Gus grunted to Joe. "There's another bargain hunter who's going to get stung before he's through."

Several days later Estey drove up to the Model Garage in a car like the one the two garagemen were trying to sell for Hamilton.

"What do you think of this boat?" he called, as he stepped from his car. "Just stopped around to show you highbinders I know a bargain when I see one. I bought it from a dealer over in Flintville for two hundred less than you wanted for yours. You ought to drop your price at least three hundred after seeing this."

And, at first glance, Estey's purchase appeared worth at least that much more than the other. Gus walked around it several times, eyeing it keenly.

"Thanks for showing it to us, Estey," he said pleasantly. "Now that I see what you can get for the price you paid, I'm going to raise mine another hundred!"

"What are you trying to do, kid me?" snapped Estey.

"NOT at all," Gus replied. "You asked me what I thought of your purchase and I'm telling you my first impression. Let's trundle it around a bit and see whether I ought to apologize."

Gus climbed behind the wheel and Estey got in beside him. The gray-haired mechanic eased the lever into first and let in the clutch very gently, but the car started with a jerky motion. Then he threw it into second and stepped on the throttle. There was a grinding roar from the gears as the car picked up speed. He dropped into high and again gave it the throttle. A whining hum became quite audible.

"Sorry, Mr. Estey," said Gus, "but I'm afraid I can't take back what I said. From the feel of it, this crock's been driven forty thousand miles if it's been driven an inch."

"Look at the speedometer," snapped Estey. "It shows the car's been driven only a little over eight thousand miles."

"Turning the speedometer back is what they call 'reconditioning' in the 'gyp' secondhand auto business," Gus explained. "That, and slapping on the cheapest coat of paint they can get."

"YOU'RE sore because I didn't buy from you," grinned Estey.

"Humph!" Gus growled. "Why should I be sore? I'll find a customer for that car all right. I haven't been in the auto business since the days of the one-lung chugger without learning something about the critters. And if you want to know how I know this car's a worn-out old wreck, I don't mind telling you. Notice how that clutch works? Kinda rough, isn't it? That's because the clutch facing is almost worn out. Did you hear those gears growl in second with a sort of a clicking noise? That's worn gears with a few chips knocked out of them, and probably loose transmission bearings in the bargain. And you'll notice there's a pretty stiff whine whenever I give it the throttle. A rear end has to be in pretty rotten shape to make so much noise. And from the muffled effect, I'm almost sure both the transmission and the rear end are full of fine sawdust. That's a regular trick to quiet gears. We'll find out about that when we get back to the garage."

"I'LL believe that when I see it," Estey growled.

"There's a plenty you could have seen if you'd only looked for it," said Gus. "Look at that clutch pedal. It's a dead give-away. No clutch pedal could be so worn in any eight thousand miles. And the brake and (*Continued on page 154*)

A Radiotron for every purpose

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RADIOTRON UV-199
Detector Amplifier

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RADIOTRON UV-886
Ballast Tube

The standard by which other vacuum tubes are rated

RCA Radiotrons are standard equipment in fine radio sets of all leading manufacturers. The RCA mark on the vacuum tubes of any radio instrument is one of the first tests of its excellence.

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To maintain high quality performance in your radio set, replace all the vacuum tubes with a new set of RCA Radiotrons at least once a year. Do not put new tubes with old ones that have been *long* in use.

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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

These Kinks for Your Car May Come in Handy

If You're Stuck in the Mud

Or if You Break an Axle, There's a Simple Way Out of the Emergency—Ideas Which, if Heeded, Make Hard Jobs Easy

ONE man can pull a car out of a bad mud hole with a rope, a stake driven into the ground, and a wooden pole such as a fence post or a limb of a tree. Fig. 1 shows how it is done. The forked stick which translates the pull into upward motion is not absolutely necessary, but will help a good deal.

Tie one end of the rope to the car axle and tie the other end to the stake, leaving plenty of slack. Now pass the rope loosely around the pole a couple of turns, insert a stout stick under the part of the rope leading to the car, and pass one end of the stick back of the pole. The stick forms a lever that will multiply your pulling force many times. The smaller the pole the greater the leverage.

Fig. 1. How an emergency lever can be improvised to enable one man to pull a car out of the mud.

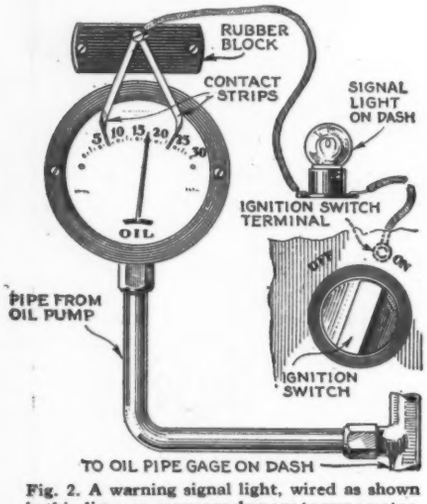


Fig. 2. A warning signal light, wired as shown in this diagram, may save damage to your motor.

Oil Failure Warning Light

WHILE the oil gage on the dash indicates plugged oil pipes by registering excessive pressure, or oil-pump failure by a low pressure reading, you may not happen to look at the gage. Figure 2 shows how to install an electric indicator lamp that will immediately call your attention to any oil failure in case you do not notice the warning of the oil gage.

Procure an extra oil gage and mount it on the back of the dash. Remove the glass. Mount a fiber or rubber block just above the gage and on it fit a couple of light brass fingers arranged to make contact with the gage pointer. The proper settings will, of course, depend on the characteristics of your particular car.

Wire a dash indicator lamp as shown. When the ignition is turned on the bulb will light until the starting of the motor runs the oil pressure up to the regular running point. If anything goes wrong with the oiling system, the gage pointer will touch one of the fingers and the light will flash a warning.

Ten Dollars for an Idea!

THIS month's $10 prize goes to J. L. Longino, of Pine Bluff, Ark., for his suggestion of the handy jack base shown in Fig. 3. Each month POPULAR SCIENCE MONTHLY awards a prize of $10, in addition to regular space rates, for the most useful ideas for motorists. Other contributions are paid for at usual rates. Address the Technical Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

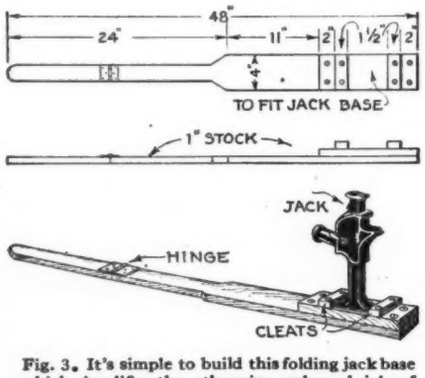


Fig. 3. It's simple to build this folding jack base which simplifies the otherwise awkward job of slipping the jack under the car's rear axle.

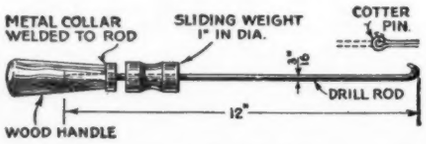


Fig. 4. With the hook inserted in the cotter pin eye, forcing the weight back pulls out the pin.

A Handy Jack Base

YOU can simplify the problem of slipping the jack under the rear axle by making the folding base for the jack, shown in Fig. 3. Cleats hold the jack in place.

The length of the base can be made to suit the car and the hinges can be located to make the base fold into the tool box.

Cotter Pin Extractor

THE design for a simple, homemade cotter pin extractor that will pull the tightest pin with ease is shown in Fig. 4. A metal collar is welded near one end of a piece of drill rod. Then a sliding iron weight is fitted to the rod and the other end of the rod is pointed and bent into a hook. To use, hook into the eye of the cotter pin and move the sliding weight forcibly against the handle. A few hard blows are generally sufficient to remove the most stubborn cotter pin.

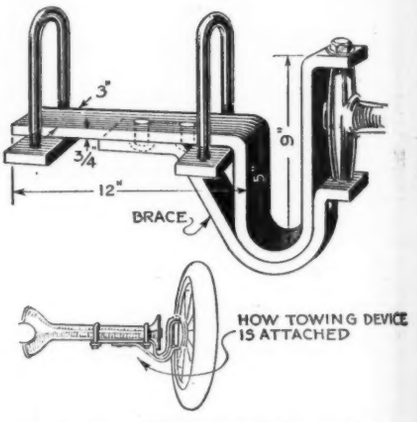


Fig. 5. An emergency towing axle made from two U-bolts, some strap iron, and a front axle.

A Towing Axle from Scrap

TWO U-bolts, some pieces of strap iron, and a front axle can be fitted together to form the emergency towing axle shown in Fig. 5. If the car axle has broken off at the wheel, this auxiliary axle can be bolted to the axle housing, making it possible to tow the car to a service station where the broken axle can be replaced.

The making of a CeCo TUBE

PROBABLY no manufacturing process is more exacting or requires greater skill and precision than the making of radio tubes.

First among the exacting steps is the assembling of the grid. Then comes the mounting of the elements on the glass stem, and inserting into the open end glass bulb and sealing the stem to the bulb.

Evacuation of the air and gases within the bulb by a special exclusive CeCo process then follows, and after "flashing" to remove all gases clinging to the sides of the bulb, the tube is "aged" by burning the filament at an abnormal filament voltage, thus "priming" it ready for use.

Finally tubes are tested for all characteristics and the close test limits assure every CeCo Tube being uniform and worthy of bearing the CeCo label.

Description of CeCo tubes here illustrated

Type M-26 (226) Amplifier: A 1½ volt, 4 prong, UX base, 1.05 amp A. C. tube for operation on alternating current through a step down transformer.

Price $2.50

Type N-27 (227) Detector and Amplifier: A 2½ volt separate heater type A. C. tube. While generally a detector tube, it may be used as an amplifier as well. Having 5 prongs its use requires a 5 prong socket and operates from A. C. current through a special down transformer.

Price $5.00

for A-C Sets

MEMBER R.M.A.

UNTIL you actually hear these remarkable CeCo Tubes perform in your own set, you have no idea of the clear bell-like tone and beauty of reproduction they make possible. Long wearing, too—these CeCo's (and, incidentally, there is one for every radio need). A new and exclusive process of evacuation not only gives them greater clarity and sensitivity, but makes them last longer as well. Try them.

Write for a copy of our booklet, "Getting the Most Out of Your Radio." CeCo Tubes are for sale by the best dealers everywhere

CeCo Manufacturing Co., Inc., Providence, R. I.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Trick-Performing Puppy

Made of Wood and Worked by Strings —Four Other New, Inexpensive Toys

Fig. 1. Animated dog show given in a tiny theater that conceals the operator.

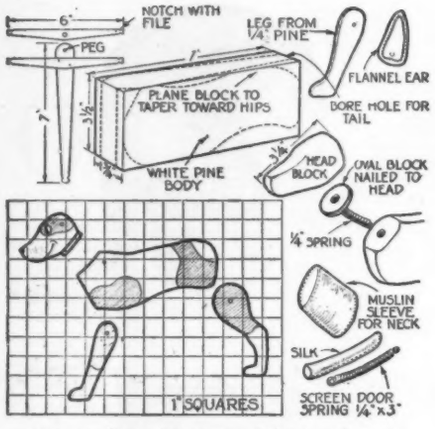


Fig. 2. How the parts of the toy dog are prepared; neck joint and tail; and top view of the "controller" for pulling the strings.

IN EVERY neighborhood there is a puppy. Even if he isn't your own puppy and doesn't bury his bones in your garden, you find his antics amusing. By making a wooden copy of him—a puppy puppet—and burlesquing his tricks, you will have a lot of fun.

This animated little dog (Figs. 1 and 2) is made from a block of white pine 1¾ in. thick, a piece of the same wood ¼ in. thick, and two coil tension springs about ¼ in. in diameter (similar to those used on light screen doors). You will also need some small nails, cloth, black ink, and a small jar of show-card white.

Lay out on paper a plan with 1-in. squares as shown. Sketch in outlines of head, body, and legs; transfer these to the wood; and rough out the various shapes with keyhole or coping saw. The block for the body should be tapered toward the hips. Round the corners, particularly at the beginning of the neck. The head also should have a pronounced taper toward the muzzle and be rounded at the crown.

Cut an oval piece from the ¼-in. wood to be nailed to the base of the head. This is so that the white muslin neck "sleeve" can be tacked on neatly. A hole should be bored in this oval piece and in the body block to receive a section of coil spring, which should fit tightly. The legs are shaped with coping saw or jackknife from the thin white pine. They should move freely when nailed in place.

Note that the black spots on the dog are so arranged that they cover the leg joints. For the pupils of the eyes use black bead-head pins cut off to about ½ in. Make the ears of heavy flannel, hemmed as shown. Over the coil spring tail, slip a cover made from a silk stocking, with the hem turned inside.

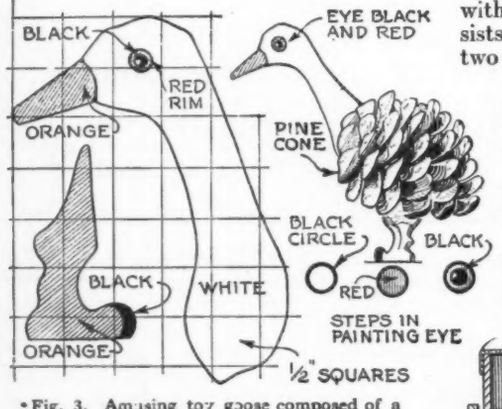


Fig. 3. Amusing toy goose composed of a pine-cone body and wooden head and legs.

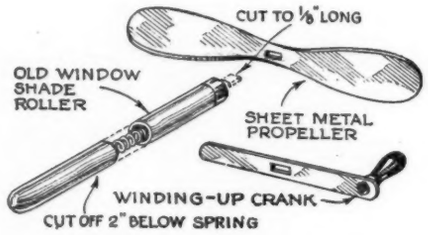


Fig. 5. Old shade roller adapted for spinning a flying propeller at great velocity.

The control bar is of the type originated, I believe, by Tony Sarg; at least, it is recommended by him for amateur work with marionettes. It consists of a cross made of two strips of ¼-in. pine, 7 by 6 in. long respectively. Another 6-in. strip is used for the head control; this is separate from the cross, but when not in use is supported by a peg on the end of the cross.

The head is supported by stout black threads attached to each side forward of the ears, or in whatever location gives the head the best balance. For the body a thread is used on each side of the shoulders and one at the rump.

By moving the main controller forward with a rocking motion, you can give the puppy the appearance of prancing along. In the meantime the head can be moved from side to side and up and down to give a frisky action. The tail wags itself.

With practice you can make this lively little puppy do all sorts of tricks, such as jumping over cigar boxes, standing up and begging for food, and walking on his hind legs. Greater action can be obtained by attaching strings to his front knees (use tacks or cigar-box nails) and carrying them up to the long member of the controller at each side of the peg at the front end. These can be worked individually with the fingers, causing the dog to offer his paw in saluting.

The advantage of this puppet is that it requires no conversation to go with the action, though, of course, anyone can simulate a bark, whine, or squeal to add to the entertainment.—Hi Sibley.

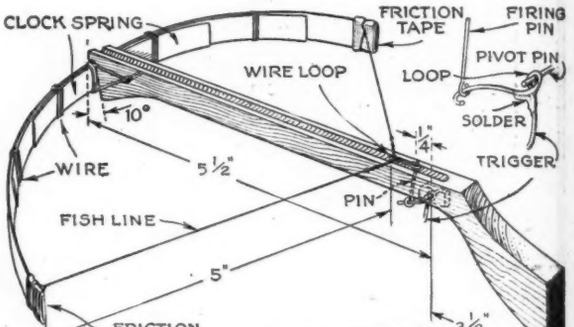


Fig. 6. Tiny crossbow for shooting match-stick arrows. The stock is whittled from wood; the bow is a steel spring.

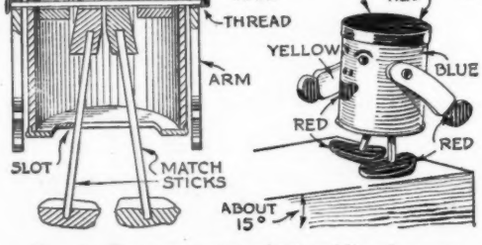
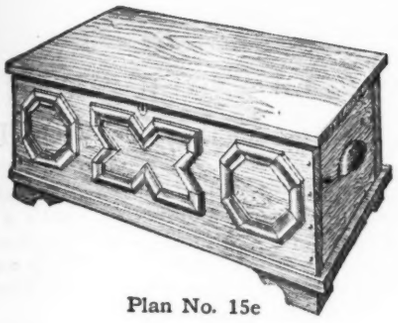


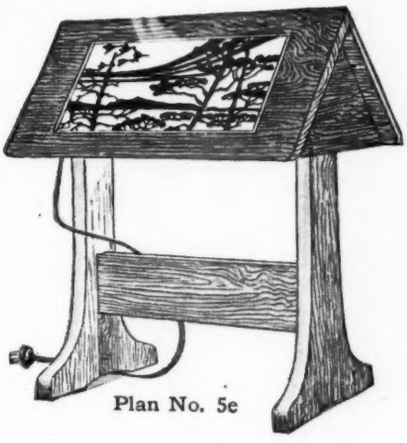
Fig. 4. Toy automaton which toddles down an incline on its legs when it is properly balanced.

FOR making the pine-cone goose of Fig. 3, cut from 5/16-in. soft pine two legs and a neck and head. Use the ½-in. squares to aid in the enlargement. (*Continued on page 129*)

MAKE THEM YOURSELF



Plan No. 15e



Plan No. 5e

Plan No. 12e

New skill for amateur hands

through Stanley Plans—only 10c each

YOU have a mechanical "turn" or you wouldn't be reading this magazine. But have you ever really experienced the pleasure of making things with tools and wood? You can make articles like the above at little cost. Thousands are now using Stanley Plans and are enjoying a useful hobby as well as the pleasantest one of them all!

There are 25 different Stanley Plans. The list is shown in the center of this page. Each plan covering every step, tells you just how to make the object—how to select and cut the wood, how to assemble the job, how to sandpaper, paint and finish it.

To do your best work you need good tools—of course! Practically every carpenter uses Stanley Tools. Manual training classes, too. Stanley makes the most complete line.

Buy your Stanley Plans from your hardware dealer. If he cannot supply you, write to us. Send 10c for each plan and ask for a free catalog of Stanley Tools. Address Advertising Department, The Stanley Works, New Britain, Conn.

Here is the complete list of Stanley Plans

No.
1e—Book Rack
2e—Candle Stick
3e—Pipe Rack
4e—Flower Box
5e—Table Lamp
6e—Toy Automobile
7e—Sconce
8e—Dinner Gong
9e—Bird Houses
10e—Dog House
11e—Book Stand
12e—Smoking Cabinet
13e—Kitchen Cabinet
14e—Sewing Cabinet
15e—Cedar Chest
16e—End Table
17e—Tea Wagon
18e—Model Sailboat
19e—Flat Bottom Rowboat
20e—Combination Kitchen Seat and Step Ladder
21e—Garden Seat
22e—Garden Trellises
70e—Small Tool Chest
71e—Large Tool Chest
72e—Work Bench

The best tools are the cheapest to use

Ask your hardware dealer

STANLEY TOOLS

The choice of most carpenters

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Tiny Monoplane Flies Indoors

Gives New Thrill Even to Experienced Model Makers—Of Advanced, Featherweight Design, Yet Not Hard to Build

When tested by Mr. Bunch on a perfectly still day, one of the models with white pine parts flew 2,200 ft.; another of balsa wood instead of pine construction went 5,000 ft.

By
J. DANNER BUNCH
and AVISON F. KOCH

PICTURE a tiny tractor monoplane flying very slowly, no faster than a person normally walks. Its large propeller revolves so slowly one can almost count the turns. On it floats, mounting higher and higher. It seems it will not run down. You have time to observe every flying characteristic, as if watching a slow-motion picture of an airplane flight or looking at some strange, slow-moving bug under a microscope.

The indoor endurance tractor is stripped of every unnecessary fraction of an ounce of weight. It has only a stick to hold the motor, a wing to support it, a tail to stabilize it, and a propeller to pull it. There is no undercarriage. The tiny ship is so light it can land with perfect safety on its propeller, which is, indeed, the heaviest part.

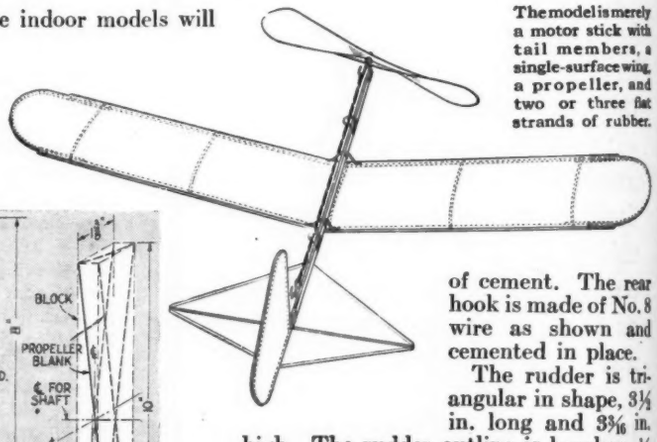
The parts are very delicate, but if you work carefully you can build a model which, despite its light weight, will stand the shock of collisions.

The model can be made of either white pine or balsa. Make your first model of white pine. You will find the experience valuable afterwards in constructing an advanced model of wonderfully light but frail balsa wood. The latter is the kind of model with which world's records are made.

Constructing these indoor models will open a new field of experimenting for many who have built previous models in the POPULAR SCIENCE MONTHLY series. Someone, by careful workmanship and perhaps with a few ideas of his own, may beat the duration record, which, at this writing, is only a few seconds less than three minutes. It's worth trying for.

The fuselage is white pine, light and straight-grained, 3/32 by 3/16 by 14 in. It should be sanded smooth and have the corners slightly rounded.

Make the propeller hanger of No. 8 piano wire. Bend a tight loop in the wire; next bend the wire downward and rearward 5/16 in., then parallel to the fuselage for 3/16 in. The hanger should hold the propeller shaft 1/4 in. above the fuselage. The hanger is bound to the top side of the front end of the fuselage with about ten wraps of silk thread and cemented, preferably with an ambroid type of cement. The rear hook is made of No. 8 wire as shown and cemented in place.

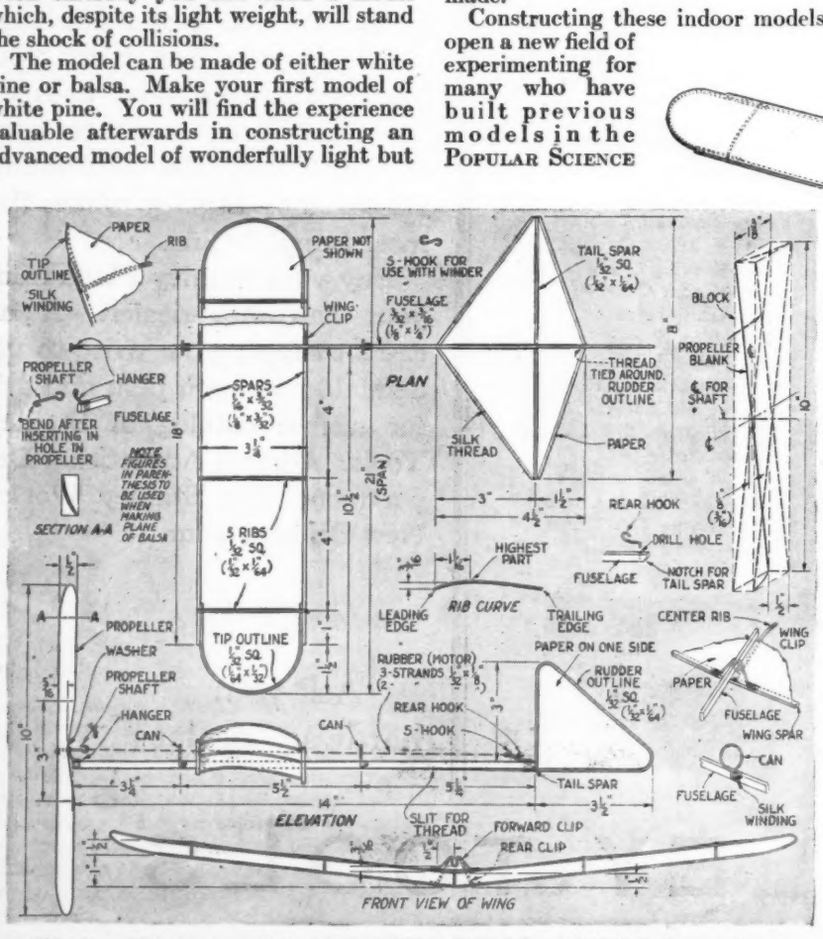


The model is merely a motor stick with tail members, a single-surface wing, a propeller, and two or three flat strands of rubber.

The rudder is triangular in shape, 3 1/4 in. long and 3 3/16 in. high. The rudder outline is bamboo, 1/32 by 1/32 in. It is a good plan to draw the rudder out full size and bend the bamboo over a candle flame to that shape. Extend the bottom side of the outline 1/4 in. and bind and cement it to the bottom edge of the fuselage. The top of the same binding holds the rear hook. Before binding the outline in place, cut a notch in the bottom edge of the fuselage for the tail spar.

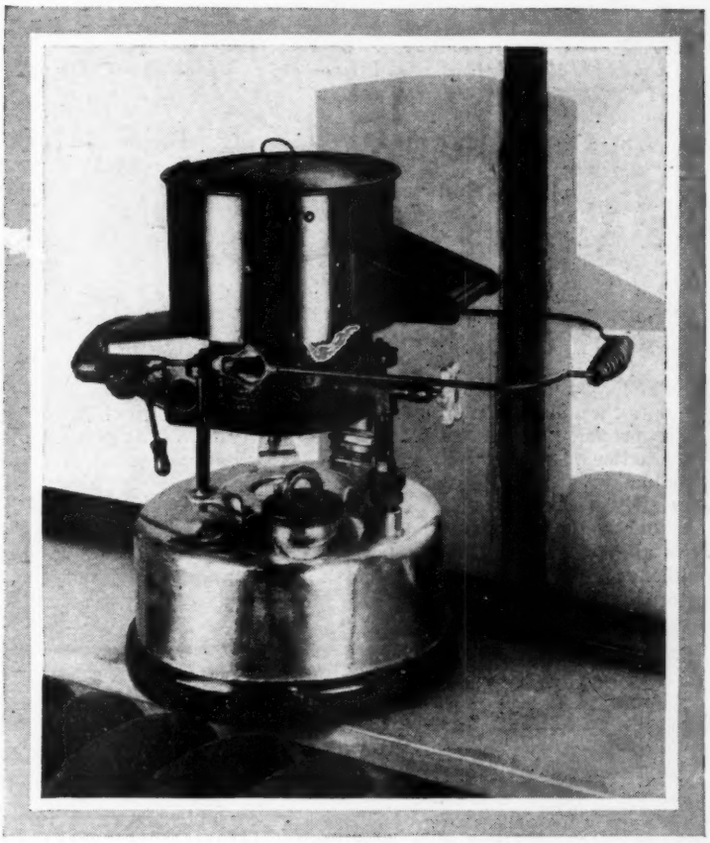
The tail spar is bamboo 1/32 by 1/32 by 8 in. Slip it into the notch and cement it. Also cement the vertical side of the rudder to the end of the fuselage. Be sure these are true and then allow the cement to set without disturbing the parts.

To complete the tail, stretch a silk thread around it as shown, and tie it to the rudder outline 1 1/2 in. to the rear of the fuselage. Pass the thread around the end of the tail spar and secure in a slit on the bottom of (*Continued on page 135*)



Side, top, and front views of the indoor endurance tractor, and details of the covering at the wing tips; the propeller, shaft and hanger; the S-hook, rear hook, wing clips and "cans."

This is the Clayton & Lambert No. 70 fire-pot with tinner's hood. Produces a working flame in ninety seconds. Flame controlled as easily as a lamp. The burner orifice cannot be enlarged by tightening the needle valve. No chance of ruining the fire-pot that way—that's an exclusive C & L feature. Will heat a pair of soldering coppers and melt a pot of metal at the same time.



Ready for use in a *minute and a half!* —and that's only part of the story.

YOU'RE going to get a real kick out of it—the first time you light up one of these new Clayton & Lambert fire-pots. No hanging around waiting for it to warm up—ready for business in a minute and a half in any weather. Cold and wind make no difference. Clayton & Lambert took care of that in designing these new fire-pots.

And after you get that hot, blue flame you can control it as easily as a lamp. Turn it up or down, just where you want it. *There's* a chance to save a lot of fuel.

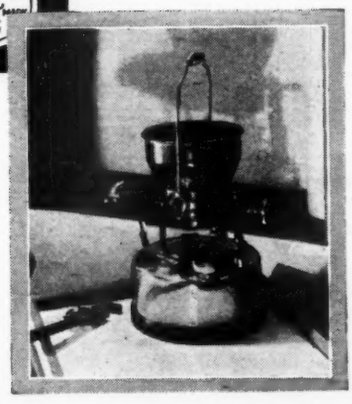
You can use it on inside jobs without annoying anybody—it's noiseless, odorless and smokeless. If you have to haul it around a lot, you'll appreciate its lighter weight before the day's over. And the rougher the work the more you'll be thankful for that husky red rim around the base which protects the tank from denting and leaking.

Either of the two Clayton & Lambert fire-pots shown on this page will burn at full capacity for six hours on a single filling, which means you can stay right with your job instead of chasing up more fuel and letting your metal go cold.

Most hardware and supply stores sell these Clayton & Lambert fire-pots. You can identify them by the bright, red band around the base of the fuel tank. If they don't have them in stock they can get them for you quickly. And you'll certainly be well repaid for being particular and asking for them by name. For the performance of Clayton & Lambert products has made this company the largest producer of fire-pots and blow-torches in the world, giving you quality articles at the savings permitted by quantity production.

"PROTECTION" C&L TRADE MFG. CO. MARK

CLAYTON & LAMBERT MANUFACTURING CO.
DETROIT, MICHIGAN



This is the Clayton & Lambert No. 60 fire-pot with plumber's shield. Tank capacity one gallon of gasoline. Burns six hours full capacity without refilling. The shield can be detached, and the handle locked, so that coppers can easily be heated.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Internal Grinding

Equipment Needed—Faceplate for Truing Long Work—Typical Set-Ups

By HECTOR J. CHAMBERLAND

The first secret of success in doing accurate internal grinding is to use a properly adjusted spindle.

INTERNAL grinding in the up-to-date shop is a daily problem. To do it properly requires attention and practice on the part of the machinist or toolmaker. And the equipment must be in fairly good condition.

A four-jaw chuck, a faceplate, and, above all, a good internal attachment or spindle, are the most necessary and important items of equipment.

The four-jaw chuck is given preference in the tool room on account of its convenience in truing up cylindrical or square work. The faceplate is used for pieces which, on account of size or shape, cannot be held in the chuck.

The spindle should be of the quill, ball bearing type if possible, because of its sturdy construction and because it eliminates any possible springing action. If other types are used, they should be inspected often and taken up for wear when necessary.

The outcome of an internal grinding job depends on the spindle. A ground hole nears perfection only to the degree made possible by the combined wheel and spindle. Skill cannot overcome serious spindle defects.

The finish on the work is an important factor; it is a question whether the job is for a press or drive fit, or a running fit. A hole ground with a wheel dressed with a manufactured abrasive, for example, and one ground with a wheel dressed with the diamond, have a very different appearance if magnified only several times. The diamond leaves the necessary square and smooth finish on the wheel and should be used whenever possible.

THE finish is not so important when the piece being ground is for a drive fit. On the other hand, for a running-fit finish the wheel should be freshly dressed before removing the last .002 in. stock on the work, and the last .001 in. should be ground off by feeding no more than .0001 in. each time across.

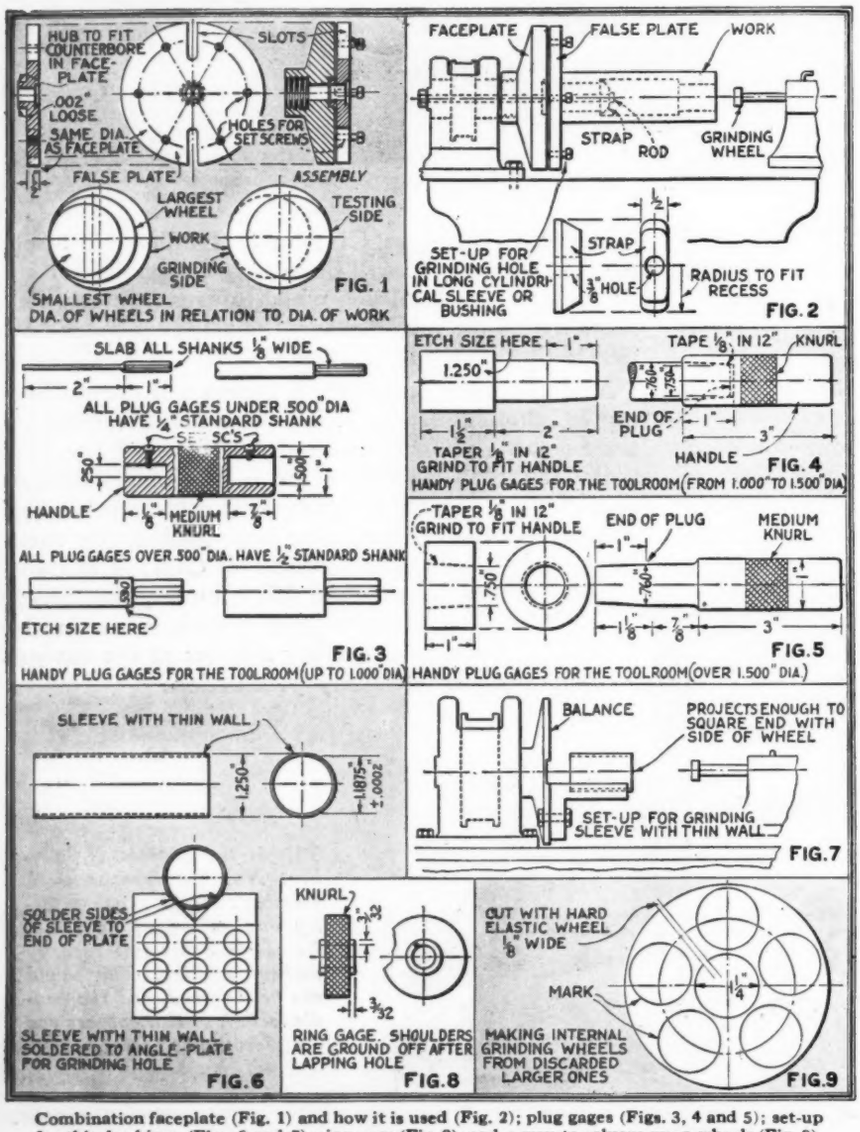
While grinding, the wheel never should project beyond either end of the work more than half its width. This will prevent bell-mouthing.

The diameter of the wheel should not be less than three quarters and not more than seven eighths the diameter of the hole. This is important for two reasons: if the wheel is too small, it will not stand up on a much larger surface; if too large, it will have a tendency to heat the work. In both cases the finish is likely to be unsatisfactory. The traverse speed of the wheel should be correspondingly in accordance with the revolving speed of the work.

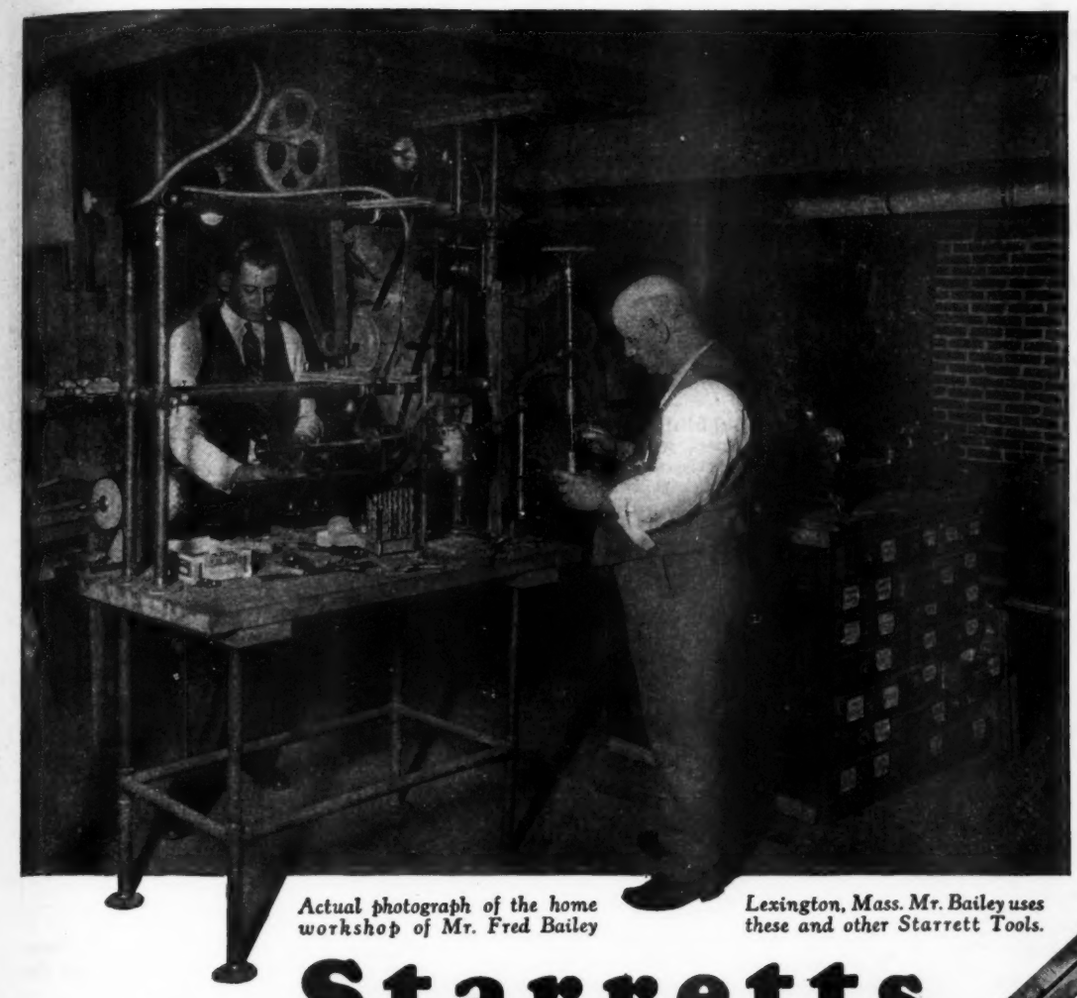
Do not force the wheel even when roughing out work. Care in this respect will help in getting a good finish and a perfectly round hole.

To find out if a hole is being ground straight, it is necessary only to work the wheel to the opposite side of the hole; this test will show if the hole is straight or if it is large in the front or in the back.

For tapering holes it is important that the wheel should grind perfectly central to the work. (*Continued on page 131*)



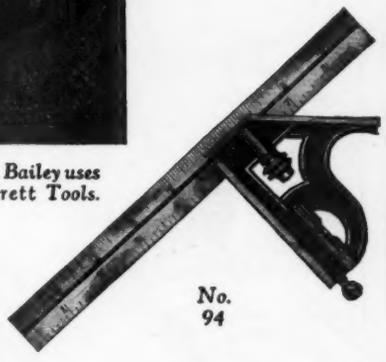
Combination faceplate (Fig. 1) and how it is used (Fig. 2); plug gages (Figs. 3, 4 and 5); set-up for thin bushings (Figs. 6 and 7); ring gage (Fig. 8); and a way to salvage worn wheels (Fig. 9).



Actual photograph of the home workshop of Mr. Fred Bailey Lexington, Mass. Mr. Bailey uses these and other Starrett Tools.

No. 436

No. 22-C



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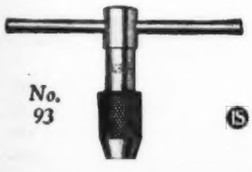


No. 93

Starretts
for the home shop

The first thing every man or boy who owns, or plans to own, a home workshop needs is the big, new Starrett Catalog fully describing and illustrating all of the fine precision tools for workers in wood or metal, whether professional or amateur.

Experts will tell you that Starrett Tools, Hacksaws and Tapes are the accepted standard for quality, accuracy and honest value.

Your tool dealer sells and recommends the genuine Starrett's. Ask him to show you.

Write now for free copy of Starrett Catalog No. 24 "W."

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U. S. A.

No. 588

No. 320-K

Use Starrett Tools

1905

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Spotting, Sawing, Stamping

Three Kinks to Save Your Time in Solving Daily Shop Problems

MUCH work in which holes have to be related correctly to each other requires the locating to be done within perhaps two thousandths. While work of this kind can be done by precision methods—with buttons or with blocks and parallels—these procedures are slow, especially where there are a number of holes. To spot such work with scratch awl, square, and center punch and get it right, requires extreme care and has the disadvantage that it is difficult to verify the location until after the boring itself—and quite often the damage—

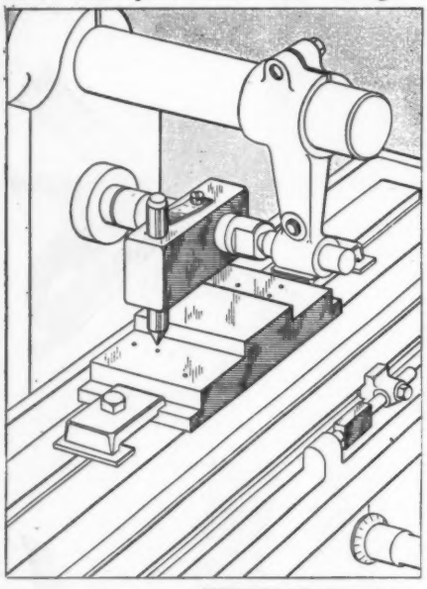


Fig. 1. Spotting attachment on milling machine for laying out work quickly and with reasonable accuracy.

has been done.

In Fig. 1 is shown a simple device that can be made at practically no cost except some odd moments of time, and by which the man in even the smallest shop will be enabled to lay out and spot many kinds of work so that it can be bored or drilled true within from .002 to .001 in. and sometimes even less. And the locating can be done so quickly that compared to some of the other methods it will look like "no time."

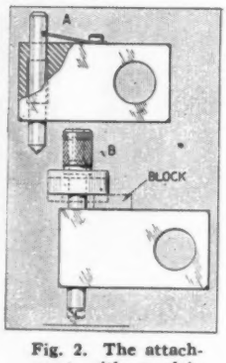


Fig. 2. The attachment with a plain punch (*A*) and with a revolving cutter (*B*).

The bore for the punch is relieved centrally so as to give a bearing only at the ends. The punch should be a snug sliding fit, with not more than .0002 in. "shake." It is best to use a punch that is ground all over. A shallow notch under the head receives the end of a light leaf spring, which normally holds the punch in the raised position.

Figure 1 shows the spotting device in use on a plain hand-milling machine, where it is held on the spindle as a cutter would be. The spindle is locked against rotation by a block of wood lightly wedged between the pulley and overarm. By using the dial on the cross feed, and size blocks or length gages between the movable and fixed stops on the longitudinal feed, the machinist or toolmaker can lay out any combination within the range of the machine.

It goes without saying, of course, that the work done with this device can be no better than the machine on which it is used. Most modern machine tools, however, have a considerable degree of accuracy in regard to the traversing movements; and unless badly worn, the slide and table are likely to move in practically a straight line and at right angles to each other. A trial made with several locations on a test plate will show what the error is.

At *B*, Fig. 2, is illustrated the same attachment fitted with a revolving cutter that permits the spotting to be done without any jarring and without causing any compression and consequent distortion of the metal such as might be troublesome in thin work having closely-spaced locations. The cutter is nothing more than a center punch of which the point has been carefully "halved off" and sharpened. It is spun with the fingers by means of the knurled handle, which is lightly driven in place on it and serves simultaneously as weight and "flywheel." A steel block slipped under the flange keeps the spindle raised when not in use.

Where the stationary stop on the cross slide of the miller (*Continued on page 122*)

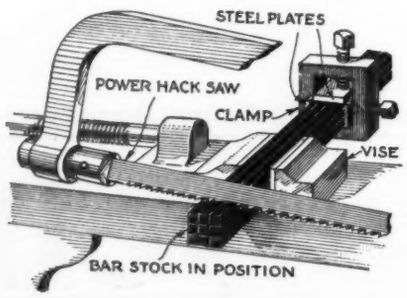


Fig. 3. A clamp to expedite the cutting of a number of pieces of bar stock at one time.

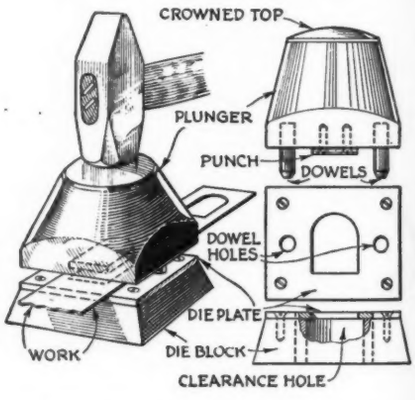


Fig. 4. Hand operated punch and die for stamping small parts without a press.

Old Bill *Says*—

GOING to and from your work is a good time to figure out that next job. To plan for a few moments sometimes saves hours of work. Remember that a good employee makes a good employer.

Turning, filing, "emerying"—as well as center friction—heat up work on centers. A good mechanic allows the work to get reasonably cool before the final "miking" to size. If this is done, the work is not likely to be undersize. Heat *will* expand metal.

When you cut a keyway in a pulley or a gear that has spokes, always locate the keyway on the center line of a spoke.

A properly ground milling cutter should have a land about one sixteenth inch wide. The angle may vary from four to six degrees, the first for steel and the last for cast iron. The relief or clearance angle back of the land should be about twelve degrees, but not more.

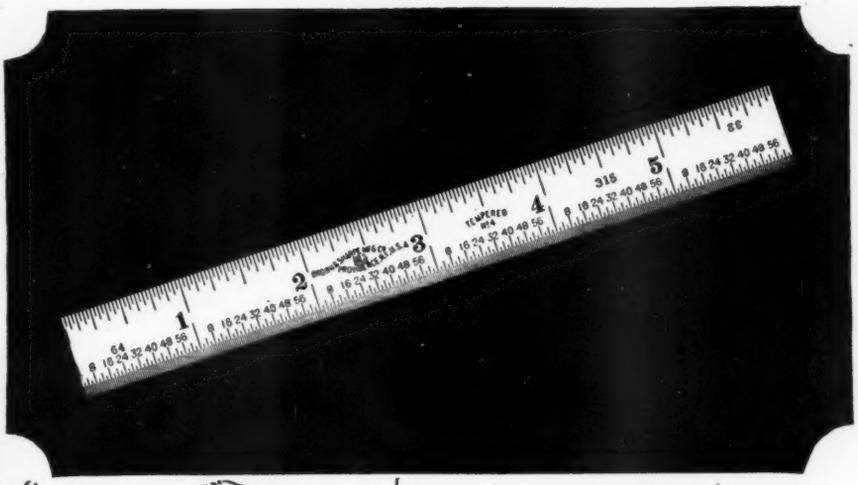
If you have any difficulty when cutting threads on steel, try a mixture of oil and sulphur on the work.

Ideas and suggestions are useful only when they are put to work.

A good thing for the beginner to remember is always to use calipers first on a piece of work. It is easy to get the work twenty-five thousandths over or under size—that is, one turn of the "mike" spindle.

An adjustable light bracket should not be attached directly to a machine; arrange a floor stand for it or fix it to the wall.

Use Good Tools For Every Job



Brown & Sharpe Steel Rule No. 315 (illustrated above) is especially easy to read. The graduations are machine divided and figured as shown.

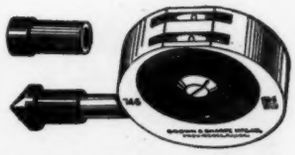
For the commonplace measuring jobs as well as those requiring extremely fine measurements, use good tools. The Brown & Sharpe line includes not only precision tools for the most exacting work, but many such general tools as the rule shown above, excellently made and handy for many mechanical jobs.

Consistent use of these high grade, well made tools will serve to keep up the quality of your work. Complete Brown & Sharpe tool equipment is a stimulus to do all your work well.

Ask your hardware dealer for Brown & Sharpe Catalog No. 30 listing over 5,000 items. If he cannot supply you, write direct to us. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

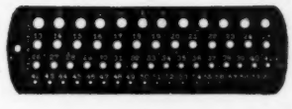
BROWN & SHARPE TOOLS Ⓢ

* MICROMETER CALIPER
No. 11 RS



* VEST POCKET SPEED INDICATOR
No. 746

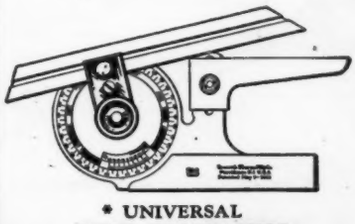
* DIAL TEST INDICATOR
No. 733



* TWIST DRILL AND STEEL WIRE GAUGE
No. 705

* RULE DEPTH GAUGE
No. 615

* AUTOMATIC CENTER PUNCH
No. 771



* UNIVERSAL BEVEL PROTRACTOR
No. 496

**A description of this tool appears in Catalog No. 30*

"WORLD'S STANDARD OF ACCURACY"

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MIDGET "SUPERRENCHES" *for Car, Radio and Home*

PRICE Complete $5.25 Post Paid

HERE'S the handiest SET of small wrenches you ever saw. Seven Midget "Superrenches", with openings from 7/32 to 1/2 inch, for those fussy little jobs ordinary wrenches can't handle. Both openings in each wrench are the same size, *but at different angles*—where one head can't operate, *the other will.* Invaluable for electrical work, all delicate adjustments and in close quarters.

"Superrenches" are thin and light, yet amazingly strong. Finished in Chrome-plate (tarnish proof), heads buffed bright. If your dealer can't supply you, write us.

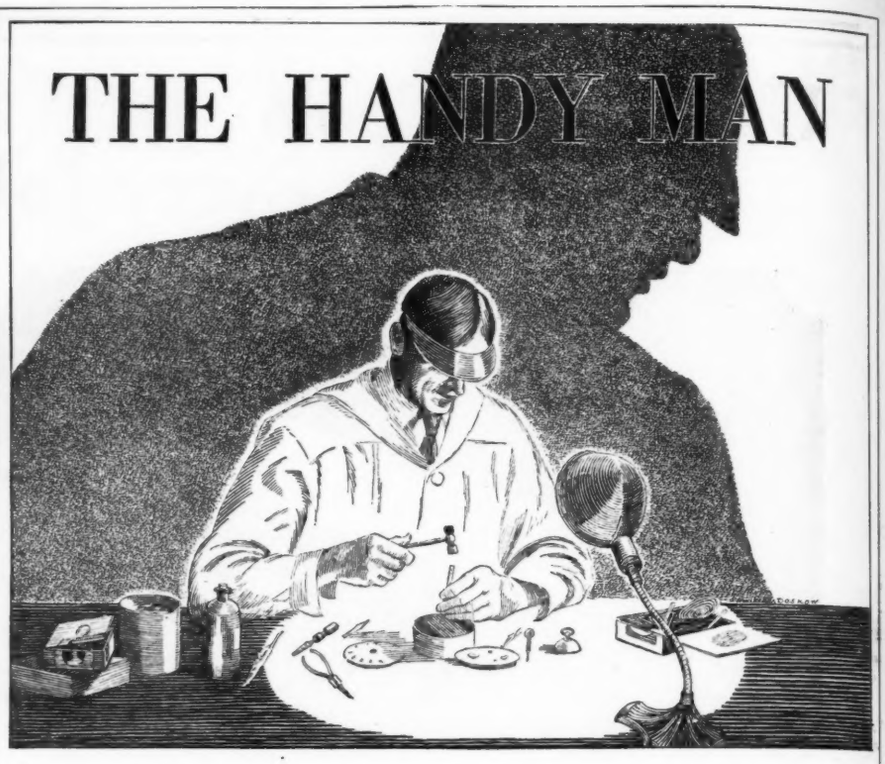
J. H. WILLIAMS & CO.,
"The Wrench People"
246 Vulcan Street, Buffalo, N. Y.

Leatherette Roll Folded to Pocket Size 5 x 4 x 3/8"

Every "Superrench" is Guaranteed Against Breakage

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
"SUPERRENCH"
(Chrome-Molybdenum)
MIDGET
ELECTRICAL SET

THE HANDY MAN



By GILBERT P. SYMONS

DO YOU know what? I wish the State Board of Education would empower me to hand out the degree of H. M. In England they might think it meant "His Majesty," but here in America it means "Handy Man."

Remember, A. B. stands not only for Bachelor of Arts, but also for Able Seaman. The Able Seaman may be dying out, but the Handy Man, never! I would find him everywhere, in almost every walk of life, but especially in the little house paid for (or being paid for) through the Building and Loan Association.

The supper dishes have been washed and Mother is about to switch out the kitchen light, when she says: "Poppa, you better buy us a new clock tomorrow. Our old one stopped today. I wound it and shook it, and it just *wouldn't* go." A gleam comes into Poppa's eyes—a gleam of sport ahead. It isn't the sport of paying out $2.79 for a new "Good Morning" from New Haven, Conn. No sir! That's a good clock, if only women knew how to treat a clock.

The women go into the living room and Pop has the kitchen to himself. Has he got everything? His reading glasses, a feather, benzine bottle, tweezers, fine screw driver, and some saucers? All right! Off with coat and vest and let's sit down to the nice enamel-top kitchen table and find out what's wrong. Let's draw "Good Morning" out of his nickel shell. Aha! Kitchen grease and fluff on the pallets of the escapement—two years of kitchen vapor. Benzine on the feather fixes that. Might as well touch up the ends of all the train arbors while we are at it.

Look again. Mother said she shook the clock hard. She certainly did, for she shook the staff of the balance wheel clear out of its seating! Now easy with the tweezers and don't strain the hair spring. A soft sound, not so hard as "snap," and then the little balance wheel is going again like sixty. Little drop of watch oil now, just for affection, on the end of a hatpin (these days Poppa has hatpins in his workbox, now that the girls don't use them).

"Good Morning" they called you, and the way you are going, old clock, it will be some time before we call you "Good Night."

Just then *I* step in on behalf of the Board of Education and view the whole works. But more, I view the man. He is glowing with pride. He had rescued something good from the ash barrel. "Man," I say, "Man, you're a wonder. You're not only a Good Man: you're a Handy Man. This diploma that I am awarding to you says so!"

Or I spy the village doctor some evening down in the laundry peering into a wash boiler. "What is it, doctor?" I ask, "Home brew?" "No, sir," he says. "As fine a piece of plastic surgery as ever I saw. The cook punched the wash stick clean through that copper bottom last week. She said the old wash boiler had sprung a leak! Didn't seem to realize that the grill top of a gas stove doesn't give much resistance to punching sticks.

What do you think of my soldering? I patched it with a penny and no disrespect to Abraham Lincoln, either."

"Honest Abe would love you, doctor. Here's another diploma: H. M.—Handy Man." (*Continued on page 110*)

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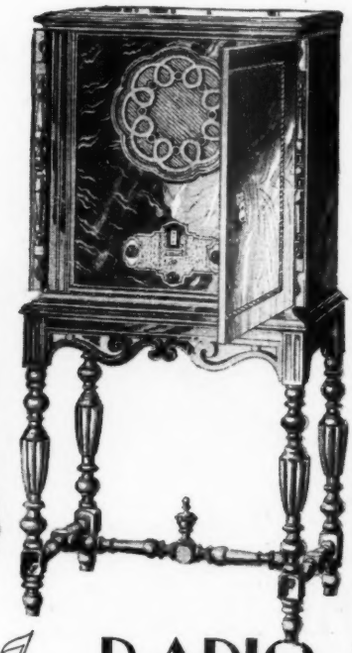
IF YOU LOOK



OR IF YOU LISTEN

RADIO QUALITY *that means* Years of Pleasure!

GREAT BROADCASTING STATIONS USE Day-Fan TO LISTEN TO THEIR OWN PROGRAMS

The remarkable tonal beauty of Day-Fan Radio is now offered in new models which are equally delightful in appearance. A set thoroughly modern in operation direct from house current, may be had in your choice of three distinguished cabinet models, of fine American walnut.

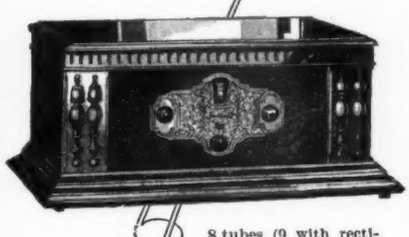
This set is new—in design, in simplicity, in performance. But again, it is built to a standard for musical instruments that is old—that does not change—excellence of tone. In years to come the quality of Day-Fan musical reproduction will be appreciated as today.

The Day-Fan 8-tube A. C. receiver is more selective; it is sensitive; it delivers splendid volume without distortion. Four stages of radio frequency, and push-pull amplification—two power tubes in combination—are largely responsible.

Single dial tuning. Auxiliary volume control. Power supply built-in part of chassis. T.r.f. circuit. Complete shielding. Connection for phonograph pick-up. Protection against voltage variation.

Table model $150 without tubes and speaker. With speaker table $205. Console $295, without tubes. (Higher in Far West).

APPROVED BY POPULAR SCIENCE INSTITUTE OF STANDARDS



8 tubes (9 with rectifier) provide an extra radio frequency stage, and two 171-A power tubes in last audio stage.

Consolette-Table Model and speaker table. A popular combination.

DAY-FAN ELECTRIC COMPANY
Dayton, Ohio

For full information, write name and address in margin below, clip, mail to us.

Day-Fan

8 All Electric Radio

8 TUBE

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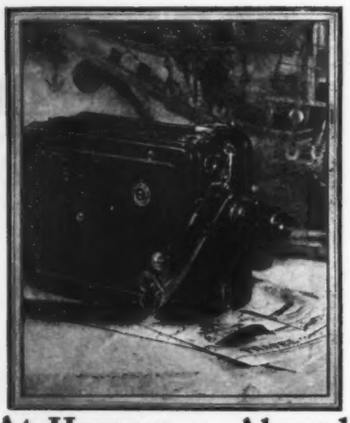


At Home ∿ ∿ Abroad

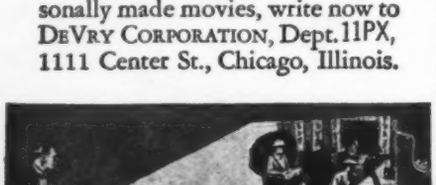
Keep Your Biggest Thrills *Forever!*

TO RE-LIVE again and again the wonders of your travels... to capture for all time the high points of home life... to make a permanent *living* record of family history... these are priceless privileges which you can enjoy, with DeVry motion picture equipment.

You take perfect personal movies from the start, with DeVry 35 mm. camera. Just point the camera and press the button. It's as simple as that! Yet DeVry meets professional requirements so fully that Hollywood's expert camera men use it for their difficult "shots." Price $150.

For clear, flickerless pictures of exceptional brilliance use reduction prints of your original films on the DeVry 16 mm. portable projector. Besides your own movies, a wide selection of travel, sport, nature, comedy and feature productions may be had for use on this home projector, at reasonable rental rates. Projector price $95.

For free literature on the personally made movies, write now to DEVRY CORPORATION, Dept. 11PX, 1111 Center St., Chicago, Illinois.



DeVry

World's Largest Manufacturers of Standard Motion Picture Cameras and Portable Projectors

THE final polish is given to the oiled and waxed top of a lowboy with a rubbing block.

Oil Rubbing Old Furniture

How to Give Antiques a Glowing Luster—Darkening New Patches—Hints on Waxing

By R. C. STANLEY, *Expert Furniture Restorer*

WHEN all the necessary patching and repairing have been done to a piece of antique furniture and the old finish has been removed as suggested in the first of these articles (December, 1927), we are ready to refinish the piece.

You may wonder why the removal of the old finish should be delayed until after the patching has been done. That is because I have found it bad practice to wash off surplus glue from newly made joints. If the gluing is done before the old finish is removed, the surplus glue comes off with the old finish. If the finish were removed first, the surplus glue would have to be scraped off, and the scraping would mar the surfaces.

My experience has been that genuine boiled linseed oil is the best agent for giving a deep, lustrous appearance to old wood. Brush the oil out thin so as to apply no more than will be absorbed by the wood. The oil will require from twenty-four to seventy-two hours to dry thoroughly, the time varying with the temperature.

There are a number of opinions as to how linseed oil should be applied—whether full strength or diluted, whether boiled or raw. A very hard wood will not absorb as much oil as a softer one, so it is well to examine the wood and dilute the oil enough so that all will be absorbed. My practice is to use one part boiled oil and one part turpentine for all wood, but to apply more than one coat if the first coat sinks in so that it is clear the wood will absorb more. If too much oil is applied, the surplus will dry on the surface and must be removed with steel wool—a very tedious and annoying job.

The accepted method for refinishing antique furniture is to leave it in the natural wood, that is, to polish the wood without the use of stains or varnish. If this finish is desired, allow the piece to stand a day after removing the old finish so that the varnish remover will evaporate entirely; then oil the wood and allow ample time for drying.

If the patches appear new and of a lighter color than the surrounding wood, there are a number of ways in which they may now be treated:

1. Make a paste of dehydrated lime and water, the consistency of thick cream. Apply this paste about 1/16 in. thick to the new wood, let it stand for a day, and remove it carefully with a scraper and steel wool. If the wood still does not look old enough, repeat the process.

2. Dilute nitric acid with an equal amount of water and apply with a fine brush or a small swab to the new wood. Allow a day for the action of the acid and then wash it off with alcohol. This method is convenient and is used by many, but I do not recommend it. The acid is dangerous in the hands of those who are not accustomed to using it; and, furthermore, it seems to me to give the wood an unnatural appearance.

3. Commercial wood dyes of the alcohol type, or spirit stains, as they are sometimes called, can be diluted with alcohol to the desired shade. These dye the wood a fast color and can be given a rubbed oil finish without difficulty.

4. There are also trade preparations; in fact, I use one exclusively and find it gives better results than the preceding methods.

When the new (*Continued on page 121*)

SAY GOODBYE to Hard Hand Drilling

A Complete Electric Workshop *including this ¼" Drill* for only $68.00

MILLERS FALLS TOOLS SINCE 1868

The Lathe-Bed is 34" long, with Head and Tailstock, and has working capacity up to 16".

Power is supplied by sturdy ¼" Standard Millers Falls Drill pictured below.

Making things with this workshop is lots of fun . . . profitable too. Save on your Christmas shopping this year. With this power workshop you can make toys, magazine racks, light furniture, lamps . . . all sorts of wooden and light metal articles that will delight those you give them to.

With the Electric Workshop, household repair jobs become easy. Handy around the car too. You can loosen up carbon without removing the cylinder head. Merely dip the wire end-brush through the spark plug holes and turn on the "juice."

Metal drilling—by hand a long, irksome job, is quick and easy with this Workshop and power drill.

6" circular saw, saw table and arbor, shown at left, cost only $10.00 extra.

11 x 12" Saw Table, including 6" Saw and Arbor — $10.00 extra.

The New Electric Workshop includes:

¼" Standard Electric Drill with 8' of cable. Universal Motor, for A. or D. C.
34" Lathe-Bed, with Head and Tailstock

Rest Socket	Long Rest	Short Rest
Spur Center	2 Pointed Centers	V Center
Face Plate Center	Cup Center	Screw Center
Adaptor	Chuck and Shank	Face Plate
4" Emery Wheel		6" Wire Brush
6" Buff Wheel		Wire End-Brush
4 Turning Tools		Wrench

Complete in 9 x 16½ x 7⅝" Steel Carrying Case, which holds everything except Lathe-Bed

No. 414
¼" STANDARD

Millers Falls Electric Drill

Only $30.00

A helper that never tires . . never feels out of sorts . . never kicks about long hours . . or wants time off

Slip a drill point into the Jacobs Chuck. Turn the switch . . . and watch it spin-bite its way through in a fraction of the time hand-drilling would take.

This drill will keep right on serving you long after many so-called "low-priced" electric drills have been retired to the scrap pile.

Write us for literature giving complete details. See your hardware man. If he doesn't carry Millers Falls Tools, ask us where you can test this Drill and inspect the New Electric Workshop.

MILLERS FALLS TOOLS

MILLERS FALLS COMPANY, MILLERS FALLS, MASS.
NEW YORK: 28 Warren Street · CHICAGO: 9 South Clinton Street.

MILLERS FALLS TOOLS

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Because

You buy a hammer or any other tool for a lifetime of use, be sure and get the type of tool that will live up to your expectations—that will stand up under all kinds of usage. In other words, look for the Pexto trademark when you buy.

A few of the popular items in the Pexto line are Braces, Bits, Chisels, Hatchets, Pliers, Pruning Shears, Screw Drivers, Snips, Squares, Wrenches and Hammers.

Write us for a booklet

The Peck, Stow & Wilcox Co.
Southington Connecticut

Two Cubical Block Puzzles

Easy to Whittle but Will Amaze Your Friends

By ARTHUR L. SMITH

IN THE article describing the common six-block puzzle or "Chinese cross" in the May, 1927, issue, it was stated that the whittler could devise new combinations at will. Those who have tried to exhaust its possibilities have found the number running into the thousands without reaching the end. If this be true with six blocks, it follows that the number of different combinations with a greater number of blocks would be increased to an indefinite sum. For many whittlers the greater part of the pleasure of whittling the puzzles lies in devising the character of the cuts for themselves. There is no danger of describing all the combinations so as to destroy this pleasure. These articles are intended to introduce readers unfamiliar with wooden puzzles to a new avenue of amusement.

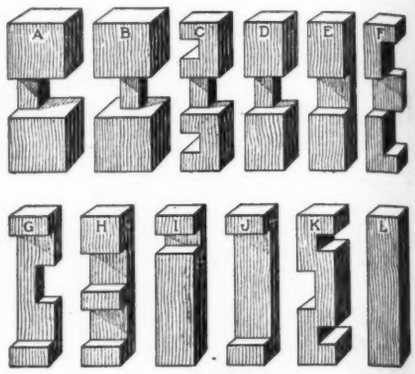


FIG. 1

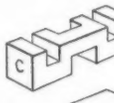


FIG. 2

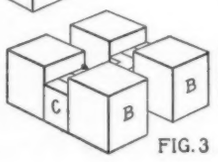


FIG. 3

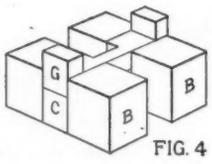


FIG. 4

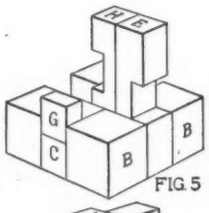


FIG. 5

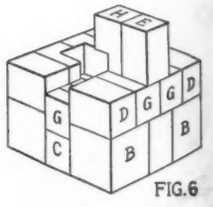
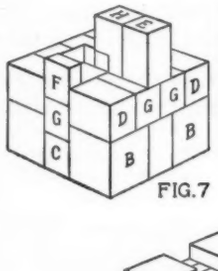


FIG. 6



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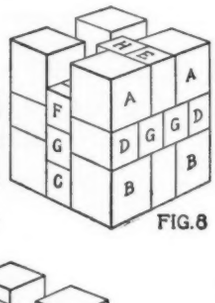

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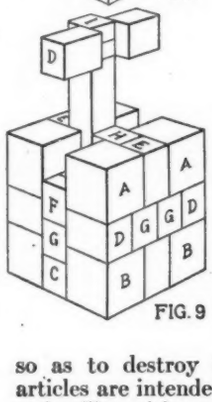

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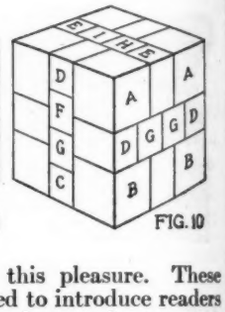

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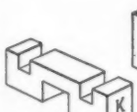

FIG. 11

FIG. 12

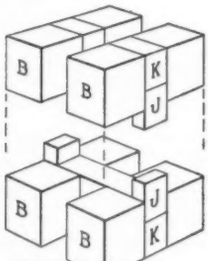

FIG. 13

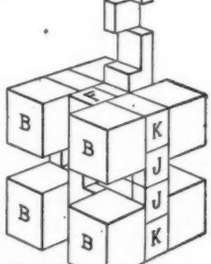

FIG. 14

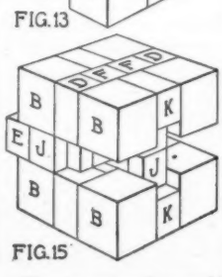

FIG. 15

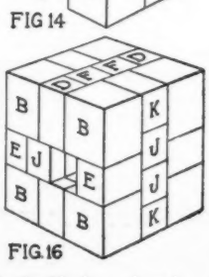

FIG. 16

How to cut and assemble the blocks. A and B are ¾ in. square; the others ½ in. square.

In a former article (September, 1927) the problem was presented of combining blocks ½ in. square by 2 in. long into the form of a cube. Ordinary cubical forms are composed of sixteen blocks of which four (A and B, Fig. 1) are ¾ in. square by 2 in. long and twelve ½ in. square and the same length. Two ways of combining these will be shown. The second is but a variation of the sixteen-block puzzle described in a former article with the exception that four large blocks are substituted for four blocks marked C in that article.

Fig. 1 shows a series of blocks which will allow of at least two combinations in the cubical form. In all the blocks except A the cuts are uniformly ¼ in. deep and ¼ to 1½ in. long. A has a cut ½ in. deep.

The first combination requires the following sixteen blocks: A A B B C D D D E E F G G G H I. The illustrations show each step in assembling, the letters being placed on the ends in all cases. Block C is placed as shown in Fig. 2. B B are fitted into the ¼-in. cuts (Fig. 3). Upon C the block G is (*Continued on page 120*)

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Mr. Brown and Mr. Jones both ride with ETHYL

but for entirely different reasons!

MR. BROWN is a thrifty soul. He knows exactly what it costs him to run his automobile. He can give you the cost per mile of tires, oil, gas and depreciation.

"I use Ethyl Gasoline for economy," says Mr. Brown. "Ethyl costs me about $1.50 more a month—but I don't have to clean out carbon. And that's a big saving. Ethyl keeps out the knock that wears and tears an engine. Then with Ethyl I get more of the power from every gallon of fuel that I use—and that appeals to me too. Besides getting the advantages of a premium fuel, I find that Ethyl actually saves me money."

EVERY day more Mr. Browns and more Mr. Joneses are meeting at Ethyl pumps. (So are their wives). In fact, at hundreds of gasoline service stations, the sales of Ethyl Gasoline now exceed the sales of ordinary gasoline. For there is nothing else like Ethyl. It is good gasoline plus ETHYL "anti-knock" compound, a product of General Motors Research Laboratories. Try it.

MR. JONES doesn't care so much about costs. He drives for pleasure. He wants power, pick-up, smoothness most of all.

"I use Ethyl," says Mr. Jones, "because it makes my car run better than it will on ordinary gasoline. It gives me high compression performance as carbon forms. It keeps me in high when the other fellow has to shift. Give me Ethyl every time! What's a mere $1.50 more a month for gas when I get a hundred dollars' worth of driving satisfaction!"

* * * *

Ethyl Gasoline is colored red for identification only. It's the tetraethyl lead in Ethyl that "knocks out that 'knock.'"

A booklet giving the facts about Ethyl Gasoline will be sent on request.

ETHYL GASOLINE

ETHYL GASOLINE CORPORATION 25 Broadway, New York City 56 Church Street, Toronto, Canada 32, Queen Anne's Gate, London, England

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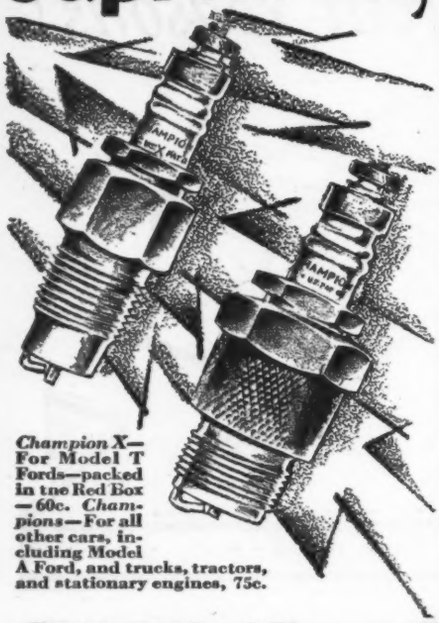

Champion X—For Model T Fords—packed in the Red Box—60c. *Champions*—For all other cars, including Model A Ford, and trucks, tractors, and stationary engines, 75c.

CHAMPION Spark Plugs outsell all other makes throughout the world, by the amazing ratio of two to one. Champion is accepted as the better spark plug.

The exclusive sillimanite insulator is impervious to electrical current, possessed of high heat conductivity, remains remarkably free from carbon and oily deposits and is practically unbreakable.

Special analysis electrodes, and a positive compression-tight copper gasket seal, make Champion specially adapted for dependable service in modern, high-compression engines.

A complete new set of Champion Spark Plugs quickly pay for themselves in gas and oil saved. They bring to your engine better all around and more economical car performance.

CHAMPION
Sparkplugs
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How to Stop Window Leaks with Putty and Paint

By F. N. VANDERWALKER, *Noted Painting Authority*

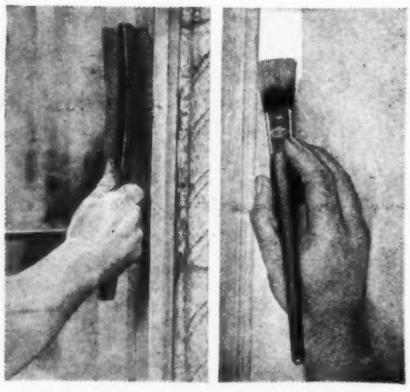


Fig. 1 (At left). Wire brushing a sash.
Fig. 2 (At right). An oval sash brush.

ONE of the most annoying features about many a new home is the leaking of window sash. The casement windows so popular today are especially likely to let in water whenever there is a driving rain. Homes that have a very narrow roof overhang are often troubled because the rain beats directly upon the window glass. After the usual scramble for mops, sponges, and pails to check the flood before it ruins the wall decorations, drapes, or floors, a few unkind words are said about the contractor.

The basic cause does, indeed, go back to the method of making the windows. They are of very dry wood, which absorbs the oil from the putty as if it were a sponge. If they are not given a coat of first-class oil paint before the glass is set and the putty put in place, the putty, even if of good quality itself, will not adhere properly for any length of time. As soon as it begins to crumble or break away, water naturally can penetrate through the window; and even if it does no especial damage inside, it will at least cause great damage to the paint and varnish inside and outside the sash.

Every specification for new window sash should require a coat of high grade oil paint before the glass is set, and also state that the putty be made from white lead, whiting, and pure linseed oil. Far too much putty is made from cheap pigments and oils, and far too many sashes are puttied after a skimpy coat of paint.

The very best glazing requires that the glass be bedded in putty; that is, after the sash bars have been painted and are dry, a ribbon of putty is run on the sash bars, the glass is put in place, the small triangular zinc glazing points are driven in, and then the outside putty is applied. A sash treated in this way with good putty and then well painted at intervals will never leak.

One inexpensive safeguard against leaks under the bottom of a casement sash is a small molding or drip cap. It throws the water away from the sash and onto the slanting sill.

When water runs in between the glass and sash bars of wooden window sash, examine the putty. If it is so dry and brittle that it is dropping out of place, the only economical remedy is to take out the sash one at a time and remove the old putty with a putty knife or an old wood chisel. If part of the putty is firmly attached and part cracked, it is possible on some jobs to remove merely the loose putty; then paint the wood and refill with good putty.

If all the putty is firmly attached but has pulled away from the glass in places allowing the water to run between, the remedy is to apply paint not only on the putty but also on the margin of the glass itself. That will, of course, make a messy-looking job, but the paint, if freely applied, will seal all the openings. At least two coats of good paint are required. When the paint has become hard, which requires at least a week's time, that on the glass can be readily removed with a safety razor blade held in one of the handles sold for this purpose (Fig. 4).

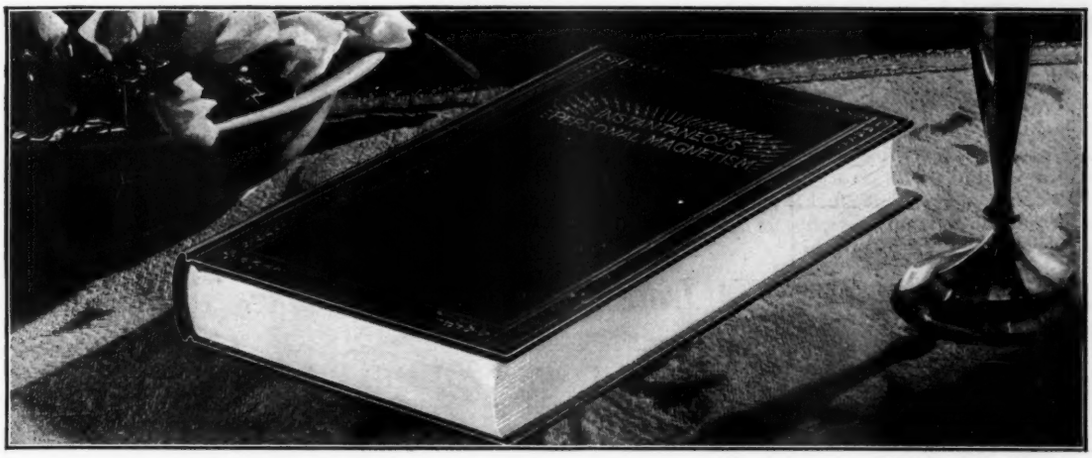
Fig. 3. Failure to apply the proper first coat caused the scaling of this steel sash.

THE best putty is made from dry whiting, white lead, and pure linseed oil. There is so much cheap putty sold, adulterated with marble dust and inferior oils, that it pays to make your own. For colored putty, dry colors such as raw and burnt umber are added to the whiting and white lead.

The procedure is to place a pile of dry whiting on a pie plate or a board and work a lump of white lead-in-oil into it. Use a putty knife until the mixture is fairly dry and then knead it like bread dough. Pounding it with a club or a mallet is also a good way to mix it well. If it gets too dry, add a few drops of oil or floor varnish. (*Continued on page 119*)

This Singular Book Wields a Strange Power Over Its Readers

Giving them a MAGNETIC PERSONALITY almost instantly!



Will You Read It 5 Days FREE—to Prove It Can Multiply Your Present Income?

A STRANGE book! A book that seems to cast a spell over every person who turns its pages!

A copy of this book was left lying on a hotel table for a few weeks. Nearly 400 people saw the book!—read a few pages—and then *sent for a copy!*

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Why are men and women so profoundly affected by this book?—so anxious to get a copy? The answer is simple. The book reveals to them for the first time how any man or woman—old or young—can develop a Magnetic Personality *instantly!* It explains how to gain *overnight* the personal charm that attracts countless friends—the self-confidence that insures quick success in any business or profession.

It tells how to draw people to you at once irresistibly — how to be popular everywhere, in any society —how to overcome almost at once any timidity or self-consciousness you may have—how to be a magnet of human attraction, popular and well-liked wherever you go!

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Whence Comes This Uncanny Volume?

Forty years ago, Edmund Shaftesbury, famous student of the human mind, set out to discover the secret of that rare quality — Magnetic Personality. He first applied his discoveries in his own circle of friends. Results were astonishing! His methods seemed to have the power of almost instantly transforming people into *entirely new beings!*

Quietly, almost secretly, Shaftesbury's fame spread. Great men came to him. His students and friends embraced such names as Gladstone, Queen Victoria, Edwin Booth, Henry Ward Beecher, Cardinal Gibbons, and others of equal fame.

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Book Tells You

- How to Develop a Magnetic Personality.
- How to use certain Oriental Secrets.
- How to gain perfect nerve control.
- How to read people's feelings by watching their mouths.
- How to read people's thoughts by watching their eyes
- How to develop a magnetic eye.
- How to make your face appear 20 years younger.
- How to control others by a glance.
- How to use Magnetic Healing.
- How to end awkwardness and timidity.
- How to attract the opposite sex.
- How to get ahead in your business or profession.
- How to make your subconscious mind work wonders.
- And dozens of other vital topics.

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Readers of this book quickly become masters of a singular power to attract others—to influence men and women around them. Not by force — not by loud argument, but rather by some subtle, insinuating power that sways men's minds and emotions. They are able to play on people's feelings just as a skilled violinist plays upon a violin.

Folks are never the same after reading this book. Their manner changes. The tone of their voice, the expression in their eyes—yes, even their actual features seem to change—seem to grow more cultured, more refined.

The eyes—windows of the soul—become clear, beautiful, expressive, luminous as a crystal sphere. The voice grows rich, resonant—mellow as a golden bell. Folks listen spell-bound—charmed by the fine modulations—the cultured fluency of the tones.

What Others Say

What priceless benefits! So profound! So far-reaching! Is it any wonder that thousands of men and women say that they are overjoyed with the results they have received? One enthusiast said of this volume, "Things I have read there I would never have dreamed of." Another wrote, "Certainly wonderful; like walking up a stairway to a higher life." Another wrote, "I would not give up what Shaftesbury has taught me for $100,000."

In your everyday life—in social life—and especially in business, you will find what these people say to be true. You will find this book of immense value. You will quickly learn to fascinate people you meet—to attract new friends—to gain the speedy promotion and big pay which always come to men and women who have developed that most wonderful of all qualities—a MAGNETIC PERSONALITY!

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You must see this book for yourself—examine it—let it influence indelibly your own personality. Merely mail coupon below and this remarkable volume, with cover in handsome dark burgundy cloth, gold embossed, will be sent you by return mail for 5 days' free examination. If you aren't stirred and inspired in the 5-day free period, return it and it costs you nothing. Otherwise keep it as your own and remit the Special Price of only $3 in full payment. This volume was originally published to sell at $5—but in order to reach as many readers as possible—it is being offered at this special reduced price. This offer may never appear again, so you are urged to act at once before it is withdrawn. Remember—you do not pay unless you decide to keep the book. You risk nothing—so clip and mail this coupon NOW. Ralston University Press, Dept. 14-T, Meriden, Conn.

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All right—I'll be the judge. You may send me the volume "Instantaneous Personal Magnetism" for 5 days' FREE Examination in my home. Within the 5 days I will either remit the special low price of only $3.00 in full payment, or return it without cost of obligation.

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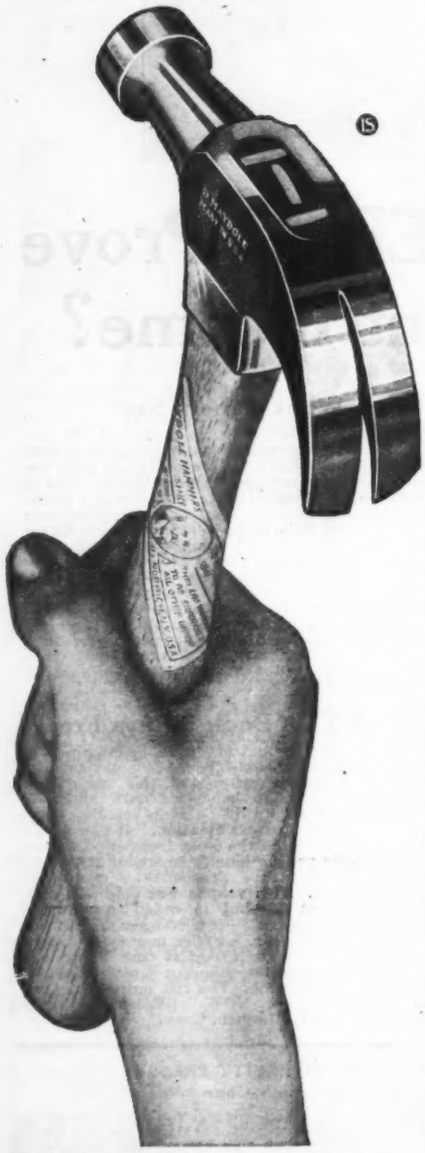
Costs More and worth it!

For those men who do their work a little better than ordinary, who want tools a little better than the rest . . . we build the Maydole Hammer.

The head is press-forged from the finest tool steel, face and claws tempered separately at each end, just enough crown on the face and sides so you won't mar the wood. Handles are carefully shaped out of clear, second growth hickory that has been thoroughly seasoned, put into the heads "for good". And every one has that remarkable Maydole "hang." Maydole Hammers are built with as much care as the finest precision tools.

Your tool dealer carries a complete stock, ask him to show you the style and weight you like best. Write for a free copy of Pocket Handbook 23-B.

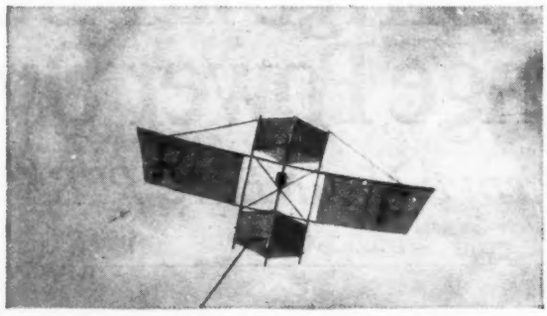


YOUR HAMMER SINCE 1843

Maydole Hammers

The David Maydole Hammer Co., Norwich, N.Y.

2187



Large airplane kite soaring with a camera—the dark spot near the center—and a clock mechanism for snapping views.

Kite Carries Camera Aloft

Has 12-ft. Wing Spread and Looks Like Airplane—Releases a Parachute

By RUDOLPH F. FISCHER

ONE of the most interesting kites I have constructed during the four years that I have been building and flying kites as a hobby is the one illustrated. It has a wing spread of 12 ft., and the over-all height is 6 ft. An alarm clock fastened to the frame serves to release a 4-ft. parachute at any time for which the alarm clock may be set. The clock also can be used to operate a box camera, with which surprisingly clear "airplane" views can be taken.

In construction the kite is unusually substantial. I have flown it nearly fifty times and have never had to make repairs.

The four main body sticks and the two main wing sticks are ⅜ by ½-in. basswood strips. Each long wing stick is composed of two 6-ft. lengths joined in the middle of the body with an aluminum sleeve. All other parts of the framework are ⅜-in. square basswood, nailed with 1-in. brads. All joints are glued and wrapped with fine wire. Twine is used for the wing braces and 26-gage wire for the body braces.

The brace wires are attached to the body wherever required by means of 1/16 by ⅜ by 1-in. aluminum strips as shown on page 98. The wood is protected with two coats of varnish. The covering is blue silk tacked at 2-in. intervals with very small tacks.

The alarm clock mechanism — the casing and glass being removed to lessen the weight—is fastened with two ⅜-in. screws to a strip of wood ⅜ in. square and 6 in. long, which is glued and wired to the kite frame.

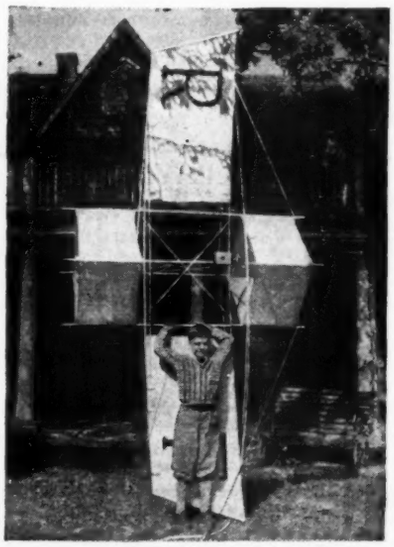
The box camera is fastened to a strip, *P*, ⅜ by ⅜ by 8 in., by means of brass screws driven through the rear door of the camera. This strip is attached to the kite by setting the lower end in the aluminum socket *G*; the upper end is held by screw *F*. The camera is rigidly braced to the body of the kite by two braces of twine or wire as shown in the top view.

A SHORT piece of strong silk line is fastened to the alarm winding key *I* of the clock so that when the alarm goes off the key will wrap the line about itself, thus drawing the line through the ⅛-in. screw eyes *J* and operating the shutter lever of the camera by means of an auxiliary lever made as shown.

The line should be provided with small hooks at *K* so that the part of the line tied to the lever can be disconnected and rehooked to pull the shutter in the opposite direction.

The parachute is released by means of a pin made of wire 1/16 in. in diameter and 2 in. long with an eye in one end. The pin slides through two ⅛-in. eyebolts. Between these eyebolts are two rings, one holding the parachute by means of a cord and two thin strips of bamboo, the other holding the parachute weight. As the clock pulls back the pin by means of a fine silk line, both rings are released and the para-

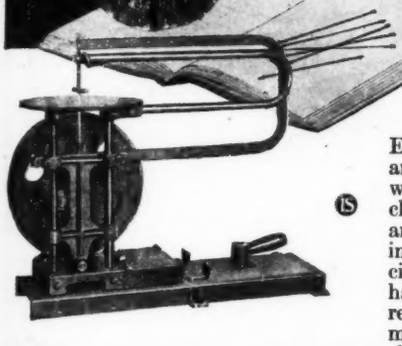
(*Continued on page 98*)



Close-up of the kite to show its size and construction. A 25-lb. string is used.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

I'll loan you a SpeedWay Shop-just to prove you can make things like this!

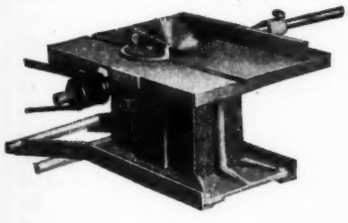


Handy Jig Saw

This pattern Makers Jig Saw is part of the model "88" Shop. Follows a perfect line. Extra blades included free.

Practical Bench Saw

Built heavy and strong. Set into place and operated in 5 seconds. Rips, miters, grooves, cross cuts.



Get Your Magazine Basket Quick!

While they last, we are giving away the lumber to make the beautiful magazine basket shown down in the lower left hand corner. It is yours to keep even if you should decide to return the shop. Act at once before they are all gone. Instructions for making it are included of course.

Yours for the Asking

Everyone who fills in and mails the coupon will receive free of all charge, illustrated plans and instructions for making this beautiful Priscilla Sewing Cabinet. Perhaps you read about it in a recent issue of a well-known magazine but I want to show you how to make it in one fourth the time on my MOTORIZED work bench—the Speedway Shop!

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Don't let hand tools put a limit on your Craftsmanship. Let me show you how to start with this simple Priscilla Cabinet—go on into grooving, mitering, mortising, scroll work, wood turning—make Humidors, Fancy Gateleg Tables, etc. Why limit your ingenuity when it is so easy to own a Speedway Shop? Remember—Speedway is the Shop used by Manual Training instructors everywhere.

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You can be sure you're getting the right shop when you realize that Speedway alone has been serving the World's Industries with Portable Electric Tools for the last twenty years. I want you to examine the exclusive features of a Speedway Shop.

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We'll show you how to earn or save the small down payments that come due just once a month. So simple too, for any man who knows his ABC's about tools. Ask what Mr. Watts of Miami, Fla., did. Send in coupon today!

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We are anxious that every owner of a Speedway Shop shall get the maximum pleasure and profit from it. That's why we have established the Speedway Personal Service Department.

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With each Shop we include 24 Blue Prints of Furniture, Toys, etc., that any one can make with the Speedway Shop. Mr. L. L. Hull in charge of our Personal Service Dept., will answer your special questions. Here is a real service department at your beck and call.

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When we receive your coupon we will send you a list of the best books on Craftsmanship from which to make your selection to be sent free with your shop.

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I will use shop for fun ☐ for profit ☐

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The "Once-Over" A Great Many Times

Before Nicholson Files take their first "bite" at a piece of metal or wood, they have been given the "once over" a great many times.

Experienced and competent men test Nicholson Files after each one of a score of manufacturing processes. As a final examination the files are tested upon hardened provers to find out if hey are sharp and uniformly hard; "rung" or struck on a block of metal to make sure that they are free from cracks; and inspected for miscuts in their teeth.

These rigid tests ensure you twelve perfect files to a dozen when you buy the Nicholson Brand.

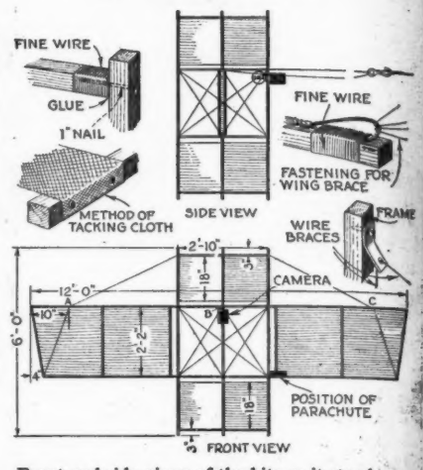
NICHOLSON FILE COMPANY
Providence, R. I., U. S. A.

NICHOLSON U.S.A. (TRADE MARK)

—A File for Every Purpose

Kite Carries Camera

(*Continued from page 96*)

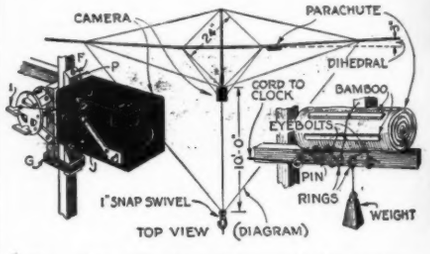


Front and side views of the kite as it stands on the ground; details of the various fastenings

chute falls clear of the kite and opens.

The kite is held at three points, *A*, *B*, and *C* (front view). The lines are brought together at a snap swivel about 10 ft. from the kite. The kite string, of 25-lb. twine, is fastened to the swivel.

I don't advise sending the parachute and clock up at the same time. Usually I set the alarm to go off about seven minutes after the kite leaves the ground.



Plan of the kite from above and the camera-operating and parachute-releasing fixtures.

White Lead Now Used for Mixing Plastic Paint

AMATEUR painters who mix their own house paints with white lead-in-oil paste can make plastic paint for textured walls and other decorative purposes by using the white lead as a base.

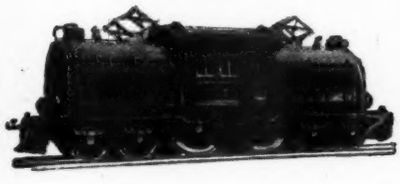
The standard formula is: 100 lbs. of white lead base, 22 lbs. dry whiting, 1½ gals. flatting oil, ¼ pt. japan drier. This will make about 5¼ gals. of plastic paint. It can be tinted with colors ground in oil exactly as ordinary oil paint. To make one gallon of the paint, take 19 lbs. of white lead base, 4 lbs. dry whiting, 1 qt. flatting oil, and 1/16 pt. drier.

The paint is applied over a priming coat or directly over old paint on plaster walls, if in good condition, and is brushed on in a thickness equal to about two coats of ordinary paint. It can be stippled with a brush or textured with a serving spoon, damp sponge, an ordinary kitchen rolling pin, or a trowel or other flat tool.

After it is thoroughly dry, it can be glazed by applying a coat of flatting oil, dabbing on spots of oil tinting colors, and blending them together with rags.

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Swift! Powerful! Handsome!



"BILD-A-LOCO"

An extraordinary new Lionel locomotive with the motor that you can take apart and rebuild. Its powerful three-speed reversible motor may also be used separately to operate other mechanical toys!

FREE

This new 46 page full-color Lionel Railroad Planning Book, describing every Lionel Model Railroad and accessory in detail. Also send us "Dad's" name and we will write him a personal letter telling him why he should get a Lionel Electric Railroad for you, and how little it costs.

You know, of course, that no other electric trains in the world compare with LIONEL for perfection of mechanical detail, for power and speed, and beauty of construction. LIONEL alone produces trains that are life-like copies of real trains. And, because of Lionel's 100% "Distant-Control" you can operate your model railroad at any distance from the track, without touching the train, controlling its forward and backward movement, or switching it from one track to another by a series of levers ingeniously arranged in the LIONEL Switch Tower. Lionel also offers every boy the greatest variety of engines, cars, work trains and accessories that it is possible to conceive. See the Lionel display at your local dealer's today! Send for the magnificent new LIONEL 46 page full-color Railroad Planning Book today! Address Dept. 2.

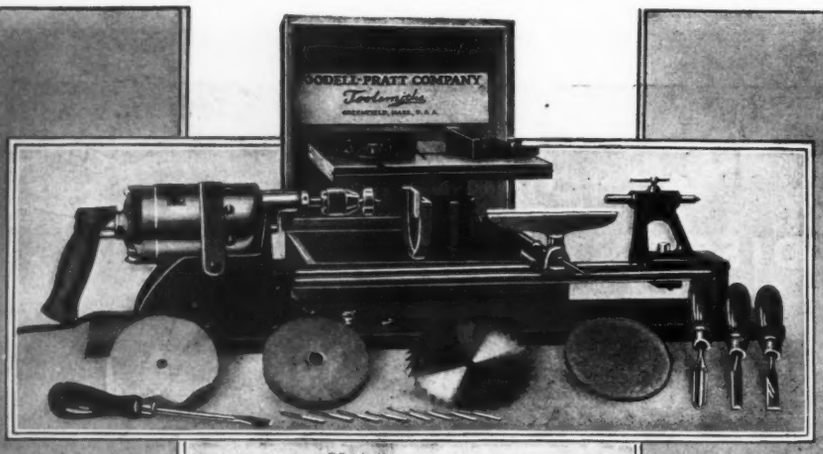
THE LIONEL CORPORATION
15-17-19 East 26th St., New York City

"STANDARD OF THE WORLD SINCE 1900"

LIONEL ELECTRIC TRAINS

MODEL RAILROAD ACCESSORIES

"MULTIVOLT" TRANSFORMERS



You can SEE this BEFORE you Buy it!

Ask your local dealer to show it to you. He probably has it in stock. Examine it. Its quality stands out. Made by a maker of good tools since 1888, you take no chances. Your dealer will guarantee it. We'll back him up. Note these features:

Power Unit

A No. 1040 1/4 inch Electric Drill; easily removable for use as a portable drill.

Lathe Unit

Practical and sturdy. Used for years on our foot power lathes. Adjustable Tee Rest and Tail Stock can be locked at any desired points. Capacity, 12 inches between centers; 5 inch swing.

Saw Table

Adjustable to cut from 0 to 1 inch. Made of wood, 9 x 10 inches, with steel inset and guard. Two saw guides for ripping and for cross-cutting or mitering.

Polishing and Grinding

A 4 inch Grinding Wheel with 1/2 inch face and a 4 inch Buffing Wheel. Can be used in lathe or portably.

Disc Sanding

Sanded Disc, with 4 inch face. Emery Cloth may be substituted for polishing or grinding.

Accessories

Three Wood Turning Chisels, Screw Driver, eight Drill Points---1/16 to 11/64 inch.

LIST PRICES

No. 1070	110V, complete	$50.00
No. 2070	220V, complete	$52.00
No. 3070	32V, complete	$52.00

If your local dealer hasn't one of these in stock, write us.

For
Sewing
Drilling
Polishing
Buffing
Grinding
Wood Turning
Model Making
Cabinet Making

The Mark of a Complete Line of Super-Performance Electric Drills

GOODELL-PRATT COMPANY *Toolsmiths* GREENFIELD, MASS. U.S.A.

GOODELL-PRATT

1500 GOOD TOOLS

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. Other subjects besides those below are to be had; send a stamped envelope for the complete list.

Popular Science Monthly,
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents

No.	*Title*	*Described in Issues of*		*Price*
1.	Sewing Table	Feb.,	'22	25c
2.	Smoking Cabinet	*Mar.,	'22	25c
3.	End Table	*Apr.,	'22	25c
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15.	Workshop Bench	Jan.,	'23	25c
17.	Cedar Chest	*Mar.,	'23	25c
18.	Phone Table and Stool	*Mar.,	'23	25c
19.	Grandfather's Clock	*Apr.,	'23	25c
21.	Colonial Desk	*Apr.,	'23	25c
23	One-Car Garage	*May,	'23	25c
27.	Kitchen-Cabinet Table	Oct.,	'23	25c
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43.	Four-Tube Receiver	*July,	'25	25c
44-45.	Pirate Ship Model	*Feb.,	'26	50c
46-47.	Galleon Ship Model	May,	'26	50c
48.	Sailing Yacht Model	*July,	'26	25c
49.	Broom Cabinet	Aug.,	'26	25c
50.	Airplane Model (Rise-off-ground tractor, 36 in.)	*Sept.,	'26	25c
51-52-53.	Clipper Model, *Sovereign of the Seas*	*Oct.,	'26	75c
54.	Five-Tube Radio Set	*Oct.,	'26	25c
55.	Five-Tube Set—Details	*Oct.,	'26	25c
56.	Bird and Animal Toys	Dec.,	'26	25c
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60.	Welsh Dresser	Mar.,	'27	25c
61.	Viking Ship Model—Hull	Apr.,	'27	25c
62.	Viking Ship—Details	Apr.,	'27	25c
63-64.	Toy Motor Boat, 29 in. long hull	May,	'27	50c
65.	Six Simple Block Puzzles	June,	'27	25c
66.	Ship-Model Weather Vane	Aug.,	'27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug.,	'27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept.,	'27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct.,	'27	25c
70.	Console Radio Cabinet	Nov.,	'27	25c
71.	Console Cabinet—Details	Nov.,	'27	25c
72.	Doll's House	Dec.,	'27	25c
73.	Doll's House Furniture	Dec.,	'27	25c
74-75-76.	*Santa Maria* Ship Model, 18 in. long hull	Dec.,	'27	75c
77.	Simple Pier Cabinet and Decorative Wall Shelves	Jan.,	'28	25c
78.	Simple Treasure Chests	Feb.,	'28	25c
79.	Electric Radio Set	Feb.,	'28	25c
80.	High Power Unit for Electric Radio Set	Mar.,	'28	25c
81.	Low Power Unit for Electric Radio Set	Apr.,	'28	25c
82.	Simple Single-Stick Airplane Model (30-in.)	Mar.,	'28	25c
83-84-85.	*Mayflower* Model	Apr.,	'28	75c
86.	Racing Airplane Model (35-in. twin-pusher type)	May,	'28	25c
87.	Seaplane Model (30-in.)	June,	'28	25c
88.	Simple Modernistic Stand; Modernistic Bookcase	Aug.,	'28	25c
89-90.	*Bremen* Scale Flying Model (3-ft.)	Aug.,	'28	50c
91.	Modern Folding Screens	Sept.,	'28	25c
92.	Simple Baltimore Clipper Ship Model (8 in. long)	Sept.,	'28	25c
93.	Three Modern Lamps	Oct.,	'28	25c
94-95-96.	Mississippi Steamboat Model	Nov.,	'28	75c
97.	Modern Radio Set in One-Tube Form	Nov.,	'28	25c

*Magazine only out of print.

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(Please print name and address very clearly)

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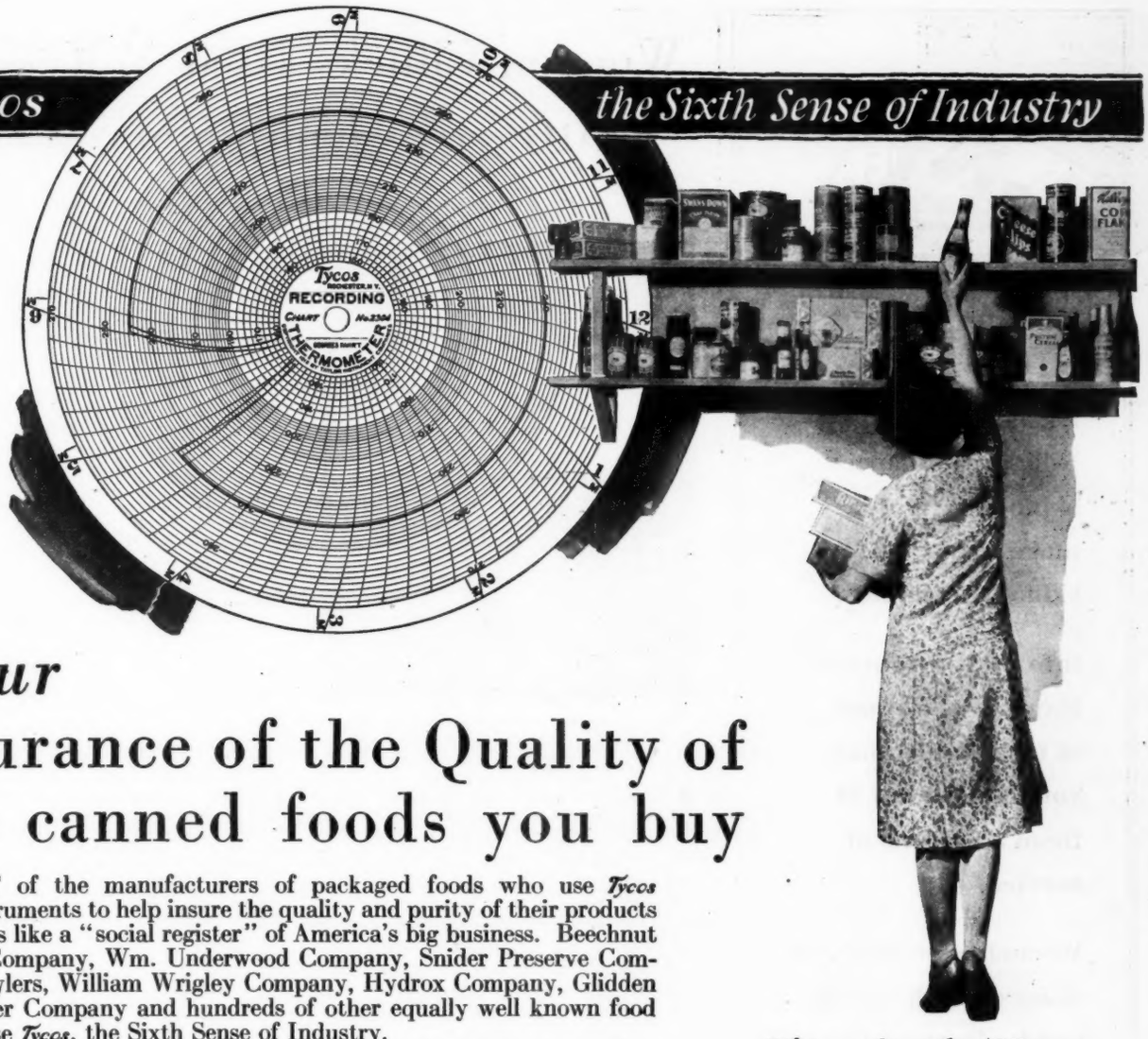
Tycos — *the Sixth Sense of Industry*



Your assurance of the Quality of the canned foods you buy

A LIST of the manufacturers of packaged foods who use *Tycos* Instruments to help insure the quality and purity of their products reads like a "social register" of America's big business. Beechnut Packing Company, Wm. Underwood Company, Snider Preserve Company, Huylers, William Wrigley Company, Hydrox Company, Glidden Nut Butter Company and hundreds of other equally well known food packers use *Tycos*, the Sixth Sense of Industry.

In one plant *Tycos* Instruments are saving $7,875 a year; in another plant turning out 500,000 cases of catsup, chili sauce, spaghetti, jams and jellies, *Tycos* has practically eliminated spoilage . . . another food manufacturer reports a $6,000 saving as a result of installing *Tycos* Instruments. And these savings are accompanied by an assurance of uniform quality that is the first essential for doing a food packing business on a volume basis.

To Manufacturers: If you are a manufacturer of any product that goes through heat treating processes in its preparation there are undoubtedly *Tycos* Instruments for Indicating, Recording or Controlling heat that will save money for you in your plant and give you the assurance of the uniform quality you are always striving for.

Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Tycos for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Tycos Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you to maintain a temperature in your house conducive to good health.

Tycos Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.

Tycos Urinalysis Glassware.

Tycos Fever Thermometers.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Bulletins on Request

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. - - U.S.A.

Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

At the forges of Billings & Spencer skilled craftsmen make wrenches for skilled mechanics.

Into these wrenches they put a lifetime of forge-craft, that you may get out of them a lifetime of service.

Wrenches steeled and shaped for the job in hand. Dependable as your good right arm.

Known as "Lifetime Wrenches" and so guaranteed. The buy of a lifetime for any mechanic or car owner.

All Dealers can supply you

Visitors are welcome at the forges of

The BILLINGS & SPENCER Company
Hartford, Conn., U.S.A.

New York: 71 Murray Street
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Wooden Chucks Used in Turning Attractive Lamp and Stand

By HERMAN HJORTH

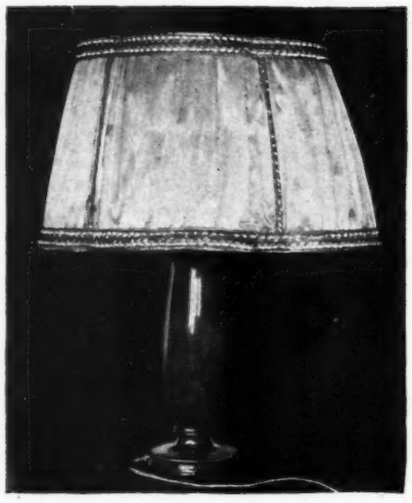


Fig. 1. Turned table lamp of a type any home worker can make on a small lathe.

THE turned table lamp illustrated in Figs. 1 and 2 consists of two parts, the upright and the base. Before the upright can be turned, a hole must be made lengthwise through its center for the electric wires. This hole may be made either by boring through a solid piece of wood or by gluing two pieces together after first cutting a groove in each.

In the first method the advantage of having a solid piece of wood is offset by the difficulties encountered in boring the hole. The auger bit to be used should have a spur for end-wood boring, and, as the ordinary auger bit is not long enough, a hole must be bored from each end. If the ends are squared accurately with the sides and the holes started on a drill press, there is a good chance to have them meet in the center; moreover, any little unevenness may be readily removed by inserting a red-hot iron rod.

The only difficulty about the second method is to plane the faces of the two pieces accurately, so that they will make a perfect joint. A groove 3/16 in. deep and 3/8 in. wide should be cut in the center of each piece before gluing.

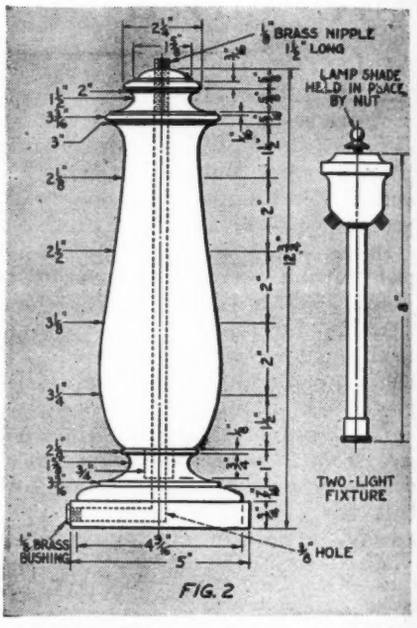
When turning the upright, block the hole in the end running on the live center (the tenon) with a piece of soft wood. The hole in the other end is left the way it is and runs on the dead center.

The base may be turned so as to avoid screw holes in its bottom. Get out the stock, plane one side, and screw it to the faceplate as explained in the article on candlesticks published last month.

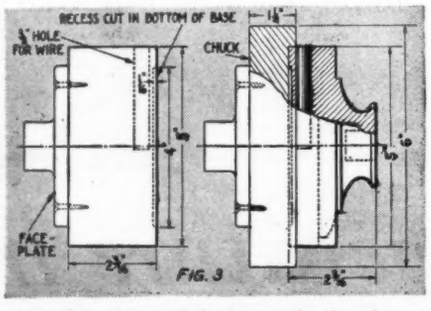
Reduce the wood to the thickness and diameter required and cut a little depression in its center about 1/16 in. deep and about 1 in. less in diameter than the total diameter of the base (Fig. 3). This is the bottom of the base, and the depression is cut to make it stand well.

Bore a hole with a 3/8-in. auger bit into the edge of the base and well past its center. Sandpaper the bottom and edge of the base and remove it.

A device called a "chuck" is now made from a piece of wood, preferably soft and at least 1 in. larger in diameter than the base. This is screwed to the faceplate, faced off, and turned to its largest possible diameter.



Graceful table lamp, the base of which is turned in a wooden chuck as shown below.



The base is roughed out on the faceplate (left), then finished in a wooden chuck (right).

Caliper the diameter of the lamp base carefully, mark this diameter on the soft wooden disk, and cut a recess into it about 1/4 in. deep. The base should fit very tightly in this recess. To begin with, cut well within the line marked and gradually enlarge the recess until the right diameter has been reached.

If the recess should be too large, place a piece of paper over it and drive the base in place. If this does not hold the base tightly, face the disk off and try again. When the base fits properly and is driven tightly up (Continued on page 108)

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Wood Turning

(Continued from page 102)

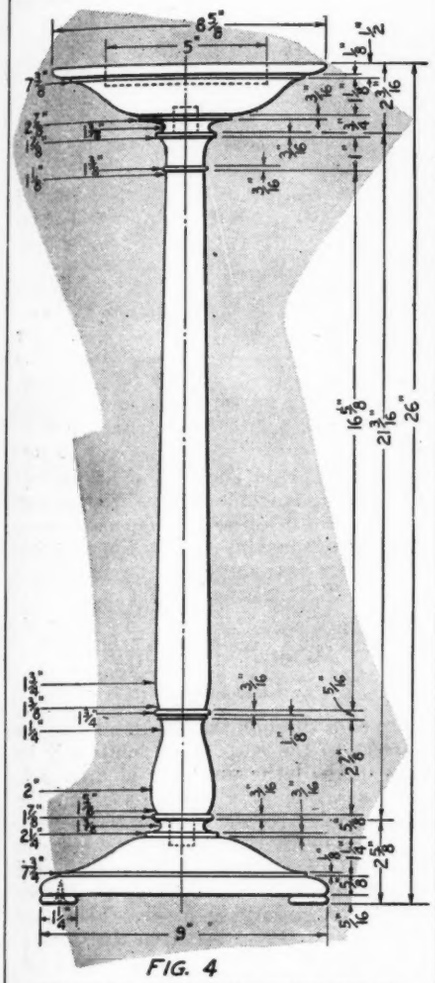


FIG. 4

This stand is an interesting project from the turner's standpoint and makes a fine gift.

against the bottom of the recess so that it runs true, it may be turned in the usual manner without danger of coming loose. This operation is called "chucking." To remove the base from the chuck, grasp it firmly with one hand and tap the face of the chuck with a hammer.

It is best to stain and finish the upright and the base separately. A ⅛-in. metal bushing is screwed into the hole bored into the side of the base, and a ⅛-in. brass nipple about 2 in. long is screwed into the top of the upright so as to project about ⅜ in. Remove the wooden plug from the lower end of the upright, pull the (Continued on page 104)

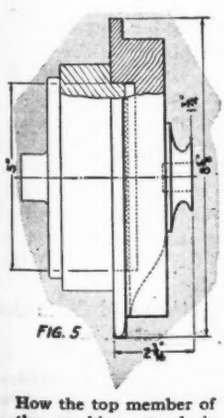


FIG. 5

How the top member of the smoking stand is held on a wooden chuck.

"YANKEE" No. 10 Screw-driver. Right and left ratchet; and rigid.

First make a Hole *For the Screw*

THERE'S one right way to do a job. And, —the right way is the speedy, easy way!

Skilled mechanics always bore holes for screws. They use the "Yankee" Automatic Push Drill: because it is quick and sure! Makes the right-size hole for the screw. Doesn't split the wood. Operated simply by pushing. A spring brings handle back for next push; revolving drill-point backward to clear chips.

Eight "YANKEE" Drill-points, 1/16" to 1/64", supplied in magazine in handle and arranged for quick, easy selection. Every drill-point individually tested.

"YANKEE" No. 41.—Companion tool to "Yankee" Spiral Screw-driver, in the hands of good workmen the world over. Price, $2.60.

"YANKEE" No. 44.—Adjustable Tension regulates pressure for boring in hard or soft woods, with large or small drills. Price, $3.15.

Ask dealer for the "Yankee" Push Drill. The genuine is always marked with the name "Yankee"—for your protection against counterfeits.

"YANKEE" on the tool you buy means utmost in quality, efficiency and durability.

WRITE us for "Yankee" Tool Book, Free, illustrating and describing many ingenious "Yankee" Tools, such as "Quick-Return" Spiral Screw-drivers, Two-speed Small Hand Drills, Ratchet Breast, Chain and Bench Drills, Ratchet Tap Wrenches, Removable-base Vises.

NORTH BROS. MFG. CO.
Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

WHIRL AWAY

—on a new "45" twin

SCURRY with the leaves over winding roads—drink deep of the keen Autumn air—feel the thrill of motorcycling at its best, in the saddle of Harley-Davidson's latest Twin — the "45".

Here is surging, silent power—lightning getaway—speed enough to pass any mile-a-minute car. Perfect balance, handy controls, and brakes front and rear make the "45" delightfully easy to ride and safe to handle. Upkeep cost is almost nothing — and the price of the "45", f. o. b. factory, is only $290.

Ask your Dealer about his Pay-As-You-Ride Plan. Go out for a demonstration — he'll gladly teach you to ride, free, in a few minutes.

Mail the Coupon for illustrated literature.

HARLEY-DAVIDSON MOTOR COMPANY
Department P. S. Milwaukee, Wis.

HARLEY-DAVIDSON
Motorcycles

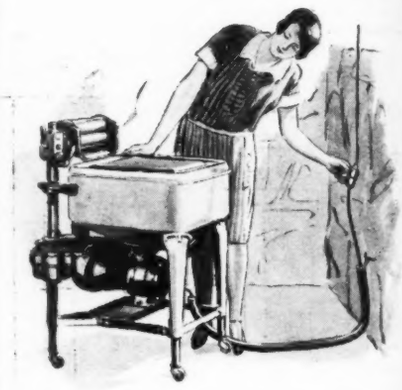
HARLEY-DAVIDSON MOTOR COMPANY
Dept. P. S., Milwaukee, Wis.
Interested in the "45" Twin—send literature.

Name.....

Address.....

City.....

Garden Hose Protects Cord on Washing Machine



Simple way to prevent an electric cord from being damaged by moisture and abrasion.

TO PROTECT the cord of an electric washing machine against friction and flood and still allow its free movement around the machine, incase it in a section of rubber garden hose as illustrated above.—E. R. SMITH.

Wood Turning

(*Continued from page 103*)

lamp cord through the hole, and glue the upright to the base. The lamp may be held in the lathe until the glue has set, the base fitting in the chuck and the brass nipple over the dead center.

A two-light fixture, such as shown in Fig. 2, is screwed to the nipple. It is fitted with two pull sockets to which the proper wire connections are made. The other end of the lamp cord is fitted with a plug.

The shape, color, and fabric of the shade is a matter of individual taste.

SIMILAR problems in turning are involved in making the smoking stand shown in Fig. 4. It consists of three main parts—the base, the upright, and the top. First turn the upright.

The base may be turned without chucking it, as it is not important to hide the screw holes. When the three little feet are screwed to its underside, it will stand firmly. Before turning these, bore 3/16-in. holes for the screws through the center of the stock. The feet are turned exactly as the exercise given under convex turning (June, 1928, issue, page 90).

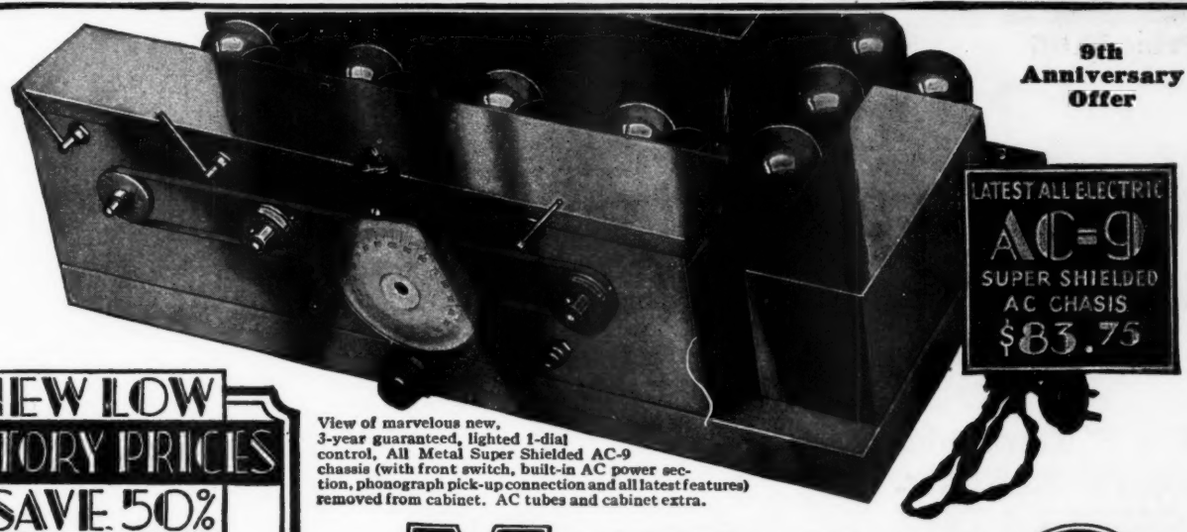
Unlike the base, the top must be chucked when turning to avoid unsightly screw holes. Instead of fitting inside the chuck, as in the case of the base for the table lamp, it fits over it and against a shoulder turned on it (see Fig. 5). The recess cut in the top is for a glass or metal tray. The diameter and depth of this recess, therefore, will vary according to the dimensions of the ash tray.

Glue the parts together and finish the stand as previously suggested.

This is the eighth of a series of articles for home workers who own small lathes and have taken up the recently revived hobby of wood turning.

Compare With Costliest Sets!

ENJOY ANY MIRACO 30 DAYS — RETURN EVERYTHING, OUR EXPENSE, UNLESS DELIGHTED



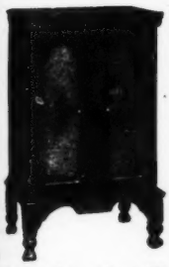
9th Anniversary Offer

View of marvelous new, 3-year guaranteed, lighted 1-dial control, All Metal Super Shielded AC-9 chassis (with front switch, built-in AC power section, phonograph pick-up connection and all latest features) removed from cabinet. AC tubes and cabinet extra.

NEW LOW FACTORY PRICES SAVE 50%

Wide Selection of Beautiful Cabinets AC or Battery Sets

30 DAYS HOME TRIAL



Richly designed, genuine walnut console of finest type. Electro-dynamic or magnetic power cone, or long air column speaker. Marvelous value.

A popular walnut Hi-Boy Console, with drop-leaf desk. Beautiful two-tone finish. Rare bargain!

Beautifully graceful Spinet console, genuine two-tone walnut. Choice of speakers. Also comes in Electric Phonograph-Radio Combination.

A new-type arm-chair console. Genuine walnut. Very pretty. Low priced. Electro-Dynamic or Magnetic-Power Speakers.

At right, a Lo-Boy console, walnut finish, that costs little. A gem!

Above, popular inexpensive combination. Set on Table Speaker (sold separately).

Metal or wood compact style cabinets. Wood cabinets in walnut or new shaded silverchrome finishes. Cathedral Electro-Dynamic or Magnetic-Power Speaker to match!

MIRACO

TRADE MARK REGISTERED

CATHEDRAL TONED, SUPER SELECTIVE, POWERFUL DISTANCE GETTERS

Celebrating its 9th successful year, America's big, old, reliable Radio Corporation springs a genuine sensation in high-grade sets. With its latest, Super-powered, 1-dial Miracos—the All Electric wholly self-contained, hum-free, AC-8 and AC-9, using AC tubes or the new 8-tube models for batteries or Eliminators—you are guaranteed values and savings unsurpassed in the fine set field.

Compare a Miraco with highest-priced radios, for 30 days in your home. Surprise and entertain your friends—get *their* opinions. Unless 100% delighted, *don't buy it!* Return everything—*the complete outfit*—at our expense. Your decision is final—absolutely!

Only exceptionally fine radios, of the very latest approved type, at rock-bottom prices, could possibly back up so liberally unconditional a guarantee. Send coupon now for *Amazing Special Factory Offer!*

BIG DISCOUNTS
Exclusive Territory to User-Agents on
BATTERY OR AC ELECTRIC OUTFITS

Don't Confuse with Cheap Radios

With its rich, clear Cathedral tone, hum-free operation, tremendous "kick" on distant stations and razor-edge selectivity—with its costly sturdy construction, latest features, including phonograph pick-up connection, ease of tuning, beauty, and economy — a Miraco will make you the envy of many whose radios cost 2 to 3 times as much!

Many thousands of Miracos—bought after 30 day home comparisons—are cutting through locals and getting coast to coast with the tone and power of costly sets, their delighted users report. Miracos are laboratory-built with finest parts, and embody 9 years' actual experience in constructing fine sets. Approved by Radio's highest authorities.

Deal Direct with Big Factory

Everything reaches you splendidly packed and rigidly tested to insure your instant enthusiasm. Enjoy the outfit 30 days—then decide. Liberal 3-year guarantee on each set. Play safe, save lots of money, and insure satisfaction by dealing direct with Radio's old, reliable builders of fine sets—9th successful year.

AC-8—$71.50

Unbeatable value in a 3-year guaranteed Super Shielded Metal Chassis (similar to AC-9 shown above).

Also New, More Powerful Battery Sets

The newest and latest in battery operated sets, designed with same advanced features used in electric sets! Same wide choice of cabinets. Highest quality, amazingly low priced!

8-tube Battery Super Shielded Metal Chassis $49.88

Tubes, batteries or eliminators and cabinets are extra. 30 days home trial on EVERYTHING!

IMPORTANT NOTICE!

"30 Day Free Trial" offers usually are money-back guarantees frequently only on the "set." Please understand that unless you are thoroughly pleased we pay return charges and refund the FULL purchase price on both the "set" and ALL equipment—tubes, cabinet, speaker, antenna (also on batteries or eliminators with ultra-8 sets). Could any offer be fairer?

MIDWEST RADIO CORP'N, 408-AN Miraco Bldg., Cincinnati, Ohio

BEAUTIFULLY ILLUSTRATED CATALOG, AMAZING SPECIAL FACTORY

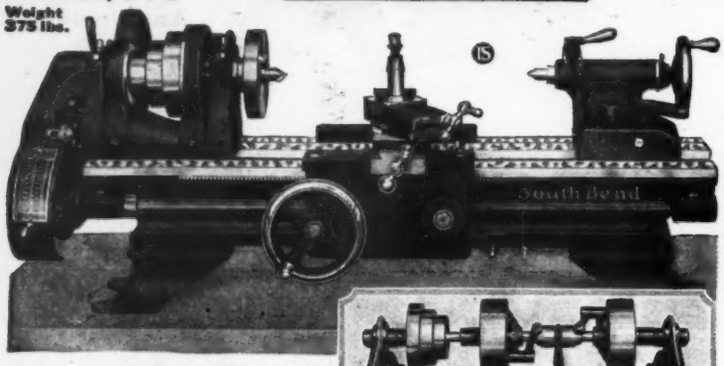
NEARBY USERS
experience

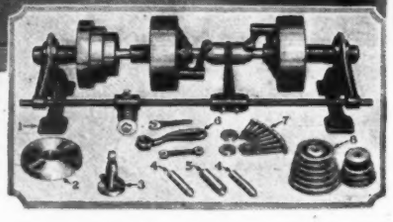
This seal on an advertisement in POPULAR Sc

Only $12.40 a Month

Price $155

Weight 375 lbs.





This Lathe Will

—Do Turning
—Boring
—Chucking
—Grinding
—Cut Screw Threads
—Make Bushings
—Reface Valves
—Finish Pistons
—Bore Connecting Rods
—Undercut Mica
—True Commutators
—and do hundreds of other jobs in the Machine Shop Manufacturing Plant Repair Shop Service Station Laboratory, and Engineering Shop

9" x 3' New Model SOUTH BEND Jr. LATHE

Back Geared Screw Cutting Precision

We ship Lathe immediately upon receipt of small down payment, and give you 10 months to pay balance in equal installments. With each Lathe we send Free Complete Instruction Book, "How to Run a Lathe."

Features and Specifications

Power Feed to Carriage
Graduated Compound Rest
Set-Over for Taper Turning
Hole through Spindle—¾ in.
Spindle Speed—48 to 714 R. P. M
Width of Belt—1 in.

Also furnished with floor legs and in three types of Motor Drive, one of which is shown below

Prices and Terms of 9-inch Junior Lathes

Size Lathe	Between Centers	Weight	Down Payment	Monthly Payment	Price Lathe
9"x2½'	11 in.	350 lbs.	$30.00	$12.00	$150.00
9"x3'	18 in.	375 lbs.	31.00	12.40	155.00
9"x3½'	23 in.	400 lbs.	32.00	12.80	160.00
9"x4'	29 in.	425 lbs.	33.00	13.20	165.00
9"x4½'	36 in.	450 lbs.	34.00	13.60	170.00

Use Lathe While Paying

You can install any South Bend Lathe by making a small payment with your order and take care of the balance in small monthly payments over a period of ten months. We ship as soon as the down payment is received.

Write for FREE Time Payment Catalog 40

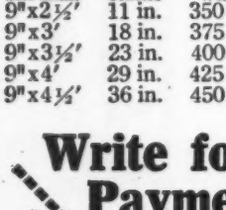
—showing 210 sizes and types of New Model South Bend Lathes with Prices, Down Payments, and Monthly Payments on each size. Catalog also shows larger sizes of lathes from the 11" swing to the 24" swing. Fill out and mail Coupon.

SOUTH BEND LATHE WORKS, 856 E. Madison St., South Bend, Ind.
Gentlemen: I would like your net factory price on a ..... Screw Cutting Lathe, size ..... for (Check) ( ) Machine Shop ( ) Garage ( ) Manufacturing ( ) ..... kind of work. Please send Free Catalog.
Name .....
Address .....
City .....
State .....

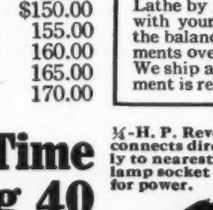
¼-H. P. Reversing Motor connects directly to nearest lamp socket for power.

Only $18.64 per month
9"x3' New Model Junior Self-Contained Motor Driven Bench Lathe, complete.

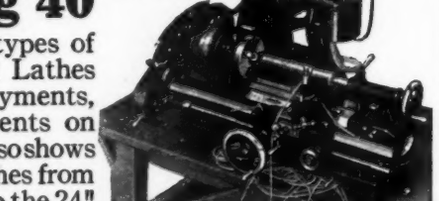
SOUTH BEND LATHE WORKS
856 E. Madison St. South Bend, Ind., U. S. A.
New York City: J. E. Beggs Co., 183 Centre St.



Gerstner Tool Cases are fully **RELIABLE.** Made so good, finished so neatly, they please the most particular men.
Machinists & Toolmakers
Get our free catalog.
H. GERSTNER & SONS



Print Your Own Cards, stationery, labels, paper, circulars, tags, menus, book etc. Save money and time, cut cost in half. Sold direct from factory. Pays for itself in a short time. **Complete Outfits, $8.85 up.** Job Press, $11, $29; Rotary $149. **Print for Others, Big Profits.** All easy, rules sent. Write for catalog of presses, type, paper, cards, envelopes, paper cutters. **The Kelsey Co., P-33, Meriden, Conn.**



Pen part smooth point.

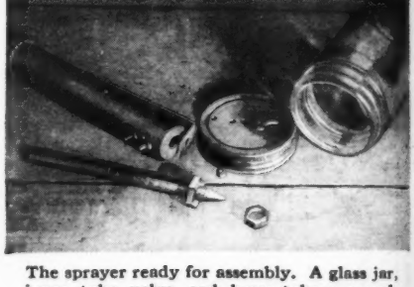
Paint Sprayer Built as Attachment for Vacuum Cleaner

By WALTER E. BURTON

Painting with a homemade sprayer operated by the air blown from a vacuum cleaner.

WITH a glass jar of the screw-cap type and a few other odds and ends, you can construct a satisfactory paint sprayer to be operated by the family vacuum cleaner. The use of such a sprayer makes painting a pleasure. It is especially suitable for producing a smooth, even finish with quick-drying lacquer.

Besides the glass jar, you will need a piece of brass pipe or tubing 7 or 8 in. long, the valve from an old inner tube, a few small stove bolts with washers, and a strip of spring brass or other springy metal about ⅝ in. wide and 8 in. long. The brass pipe should be of such a diameter that it will fit the vacuum cleaner hose snugly.



The sprayer ready for assembly. A glass jar, inner tube valve, and brass tube are used.

The inner-tube valve stem is treated as follows: The buttonlike part at one end is sawed off, and the remaining threaded tube is ground to a point. The inside valve mechanism is discarded. The tube is fastened to the sprayer lid, pointed end out, by means of two nuts such as are usually found on valves. An extension of tubing is soldered on the lower end if the jar is deep enough to require it. A small hole is drilled in the cap so as to admit air into the paint chamber.

The section of brass pipe which serves as a handle and hose connection is closed at one end by a soldered-on disk in which a ¼-in. hole has been drilled. A washer of suitable size can be used.

The spray is regulated by the spring-brass strip, which is drilled and bent as shown and fastened to the handle by means of two stove bolts. By pressing the strip down until the hole at the forward end comes (*Continued on page 107*)

...oval of the INSTITUTE OF STANDARDS. See page 8.

Paint Spraying Attachment

(Continued from page 106)

opposite that in the end of the tube, the spray is increased in volume.

Most vacuum cleaner fittings include a blower attachment. The hose from this is connected to the tube of the sprayer; an intervening section of soft rubber tubing can be used if required. When in operation, the cleaner should be supported on a block of wood or in some

The spray is controlled by pressure on a spring brass strip, which regulates the air.

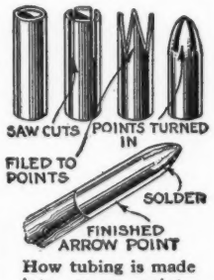
similar manner so that air can be drawn in without difficulty. A fairly thin lacquer, enamel, or paint that is free from lumps will be found best for the sprayer.

If the pressure delivered by the cleaner is not sufficient to produce a satisfactory spray, a small hole should be drilled so as to connect the inside of the sprayer handle with the paint chamber. This will cause a slight pressure in the jar, and the paint will be forced up the paint tube. The hole should not be too large, or the paint will be forced out when the regulating spring is in the "off" position.

Usually the sprayer should be held about a foot from the work, and care should be taken that the paint is not applied in too thick a coating. The best technic can be developed by practice.

How to Make Arrow Points

ARROW points may be made as illustrated from brass or steel tubing, the outside diameter of which equals that of the arrow shaft. Place the tubing vertically in a vise, make two cuts from 5/16 to 3/8 in. deep with a hack saw at right angles to each other, and with a triangular file work each cut to a long V-shaped notch. With a light hammer and pliers, bend the points together. Drop a small piece of ribbon or wire solder inside the tube and melt it by applying external heat; also add additional solder to the edges of the cuts. File off the excess solder.—J. V. HAZZARD.



How tubing is made into arrow points.

SPOTS and stains often can be removed from a felt hat with very fine sandpaper. In some cases sandpaper does the work as effectively as a commercial cleaning fluid.

Accept 10 Days' Proof

Let us prove that the claims millions of men make for this unique shaving cream are justified

GENTLEMEN:

Pullman car arguments never have yet proved a point.

That's why we make no claims for Palmolive Shaving Cream other than the fact that millions of men, once wedded to rival preparations, have shifted to this new creation.

Hence—that it is worth a trial. So we send 10-day tubes for that purpose. Will you accept one as a courtesy to us?

65 years of soap study stand behind Palmolive Shaving Cream. 129 formulas were developed and discarded before we found the right one. All our experience as the makers of Palmolive Soap, the world's leading toilet soap, is embodied in this creation.

5 new factors

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget.

PALMOLIVE RADIO HOUR—*Broadcast every Wednesday night—from 9:30 to 10:30 p.m., eastern time; 8:30 to 9:30 p. m., central time—over station WEAF and 32 stations associated with The National Broadcasting Company.*

With the new unbreakable Bakelite top

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man. Please let us prove them to you.

10 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1556, Palmolive, 3702 Iron St., Chicago, Ill.

Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

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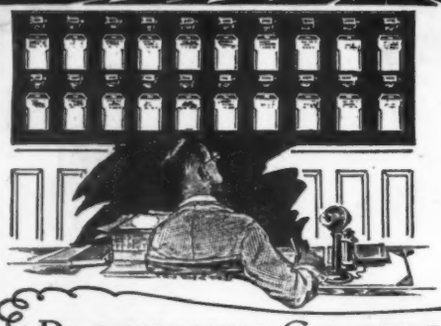
.....

.....

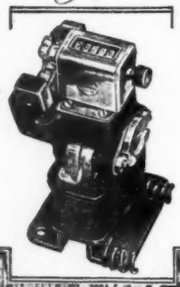
(Please print your name and address)



Veeder-Root Remote Indicating Magnetic Counters Offer

PRODUCTION CONTROL *from your Office*

You can watch and control machines in the shop without leaving your office chair. Glance up at the dials of Veeder-Root Counters, banked on a board over your desk. There, you read the production of any machine—any minute. The record, *in total*, of finished products or smallest parts. No waiting for reports from the factory. They're wired to you instantly—electrically—from machines or assembly lines.



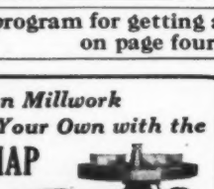
Mechanical contacts on machines in the shop make and break the electrical circuits which operate the counters over your desk. Your regular lighting circuit supplies the current. (Also counters to operate on storage battery.) Ask for our *brown book* of Counters for all machines and development-work.

Veeder-Root INCORPORATED
HARTFORD, CONN.

A definite program for getting ahead financially will be found on page four of this issue.

Cut Your Costs on Millwork by Making Your Own with the

H & A BALL BEARING SHAP



Make your own mouldings, beading, matching, etc., at a fraction of the usual cost. A sturdy, high-grade, precision tool; portable; electric. Take it right to the job. Write for catalog and prices.

HESTON & ANDERSON, 811 Western Ave., Fairfield, Iowa

OTTAWA LOG SAW

only $39

GREATEST OFFER EVER MADE

PUTS THIS OTTAWA TO WORK FOR YOU

BIG BOOK FREE

Make Money! Wood is valuable. Saw 15 to 20 cords a day. Does more than 10 men. Ottawa easily operated by man or boy. Fells trees—saws limbs. Uses 4-hp. engine for other work. 30 DAYS TRIAL. Write today for FREE book. Shipped from factory or nearest of 10 branch houses.

OTTAWA MFG. CO., 1801-W Wood Street, Ottawa, Kansas

INDIVIDUAL MACHINES MAKE THE BEST WORKSHOP!

You can do heavier work and a larger variety of jobs with individual machines in your workshop. Boice-Crane machines are each designed to give maximum efficiency and are superior in size, capacity and ability.

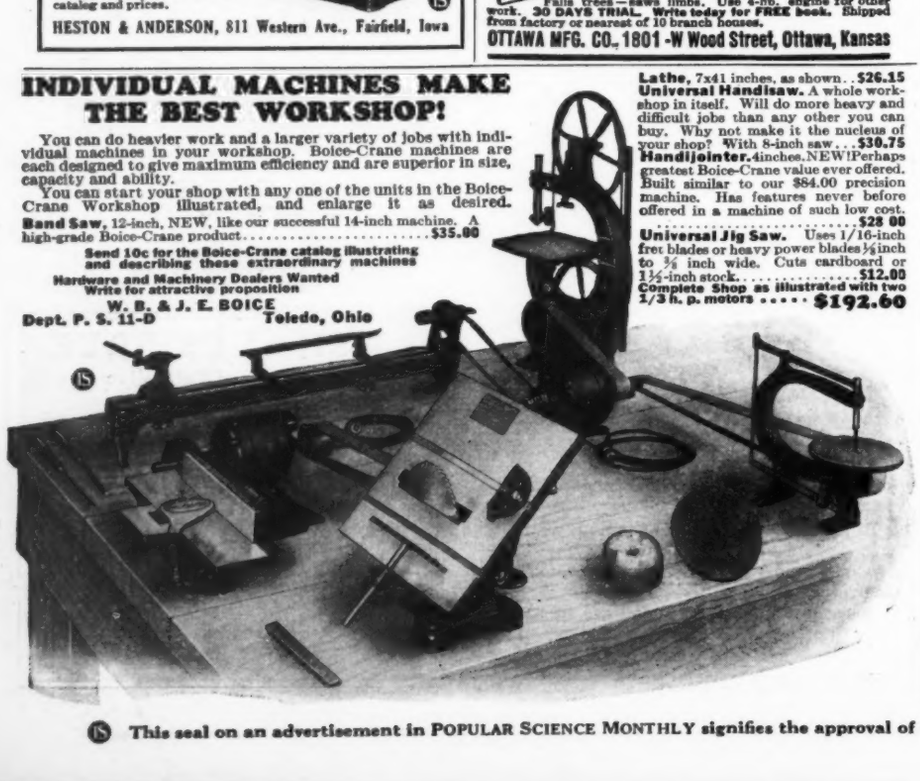
You can start your shop with any one of the units in the Boice-Crane Workshop illustrated, and enlarge it as desired.

Band Saw, 12-inch, NEW, like our successful 14-inch machine. A high-grade Boice-Crane product.....$35.00

Send 10c for the Boice-Crane catalog illustrating and describing these extraordinary machines

Hardware and Machinery Dealers Wanted
Write for attractive proposition

W. B. & J. E. BOICE
Dept. P. S. 11-D Toledo, Ohio



Lathe, 7x41 inches, as shown..$26.15

Universal Handisaw. A whole workshop in itself. Will do more heavy and difficult jobs than any other you can buy. Why not make it the nucleus of your shop? With 8-inch saw...$30.75

Handijointer, 4inches. NEW! Perhaps greatest Boice-Crane value ever offered. Built similar to our $84.00 precision machine. Has features never before offered in a machine of such low cost.....$28.00

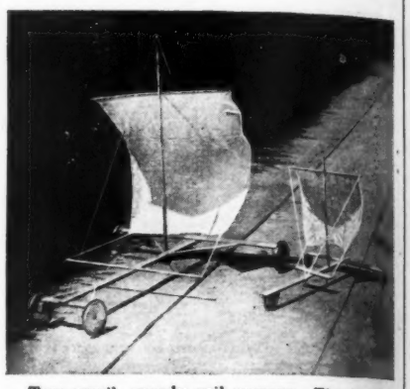
Universal Jig Saw. Uses 1/16-inch fret blades or heavy power blades ⅛inch to ⅜ inch wide. Cuts cardboard or 1¾-inch stock.....$12.00

Complete Shop as illustrated with two 1/3 h. p. motors.....$192.60

Model Land Yacht Racing Is Boys' Latest Sport

By Charles M. Miller

Assistant Superintendent of Manual Training, Los Angeles City Schools

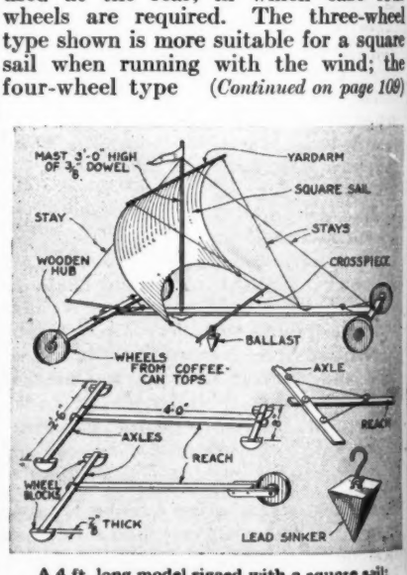


Two small, speedy sail wagons. They resemble ice yachts, but travel on wheels.

WATER yachts are tame beside these little runaways that rush along the pavements almost as fast as the wind. All kinds of sails may be used, and what with running before the wind or tacking, there are problems to keep the owner on tiptoe through all the windy playdays of fall.

Land sail wagons are sometimes large enough to carry the pilot; indeed, boys often attach a sail to an express wagon. Such crafts, however, are a nuisance on sidewalks and of some danger to old people and children. Small models give just as much fun and are proving an attraction wherever they are exhibited before groups of boys.

In the simplest form, the framework consists of a front axle and a spine, reach, or beam running from the axle to the rear end. Three wheels are used on this framework. A short axle may be used at the rear, in which case four wheels are required. The three-wheel type shown is more suitable for a square sail when running with the wind; the four-wheel type (*Continued on page 109*)



A 4 ft. long model rigged with a square sail; and both three and four-wheel frameworks.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Model Land Yacht

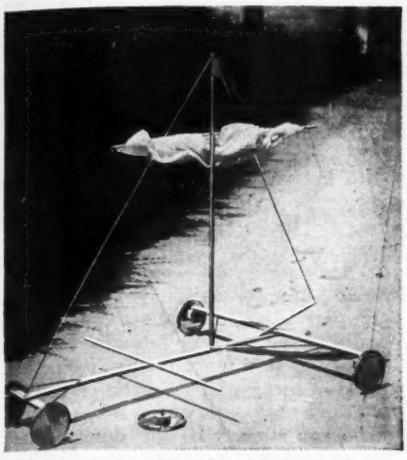
(Continued from page 108)

with an adjustable rear axle is better for tacking.

The axles and reach may be from ⅜ to ⅞ in. thick and from 1 to 1½ in. wide. For a 4-ft. model the width between the front wheels should be about 2 ft. 6 in.

The wheels can be attached by means of wheel blocks, on the axle ends, except in the case of a single rear wheel, when extension strips are used, as shown.

The tops from coffee or other tins can be made into excellent wheels. If thin screws are used, the wheels are likely to wabble; to overcome this, nail a small hub to the inside of each tin disk. The hole through the wood should be a trifle



A four-wheel model with sail furled to show construction of bowsprit and front axle.

large, the real bearing being at the center of the tin disk.

A good location for the mast is about one third the distance from front to rear. A 5/16- or ⅜-in. hardwood dowel 3 ft. high will serve as the mast, and a piece of ¼-in. dowel for the flagpole.

A square sail requires a yardarm near the top, The lower corners are held by two pieces of cord lashed to a crosspiece, which is placed about one third the distance from mast to stern. Stays from the mast top to the fore and stern ends of the spine serve to brace the mast, and stays from the ends of the yardarm prevent the sail from twisting.

A little ballast may be necessary in a strong wind—a lead sinker with a wire hook hung at any point on the crossbar.

While square sails are placed on the majority of these craft, many of which are built and used in the Los Angeles school playgrounds, it makes the sport more interesting, as soon as some experience has been gained, to rig regular yacht sails.

A Primer for Yellow Pine

YELLOW pine woodwork is sometimes primed by painters with a mixture of white lead and red lead in equal quantities, thinned with raw linseed oil, turpentine, and benzole in equal parts. The advantage of this priming is that it effectively seals in whatever pitch there is in the wood and forms a durable base for the finishing coats, whether oil paint, flat paint, or enamel undercoater.

for Men Who Take Pride in Their Tool Kits

Carborundum
REG. U.S. PAT. OFF.
Combination Stones

In attic and cellar workrooms, where zealous home-craftsmen patiently labor, there you will usually find Carborundum Sharpening Stones keeping all edge tools efficiently keen-cutting.

¶Experienced craftsmen know the value of keen, edged tools. That is why Carborundum Combination Stones are in thousands of their tool kits. The coarse-grit side removes nicks and brings the tools to an edge. The fine-grit side gives the keen, smooth, finished edge.

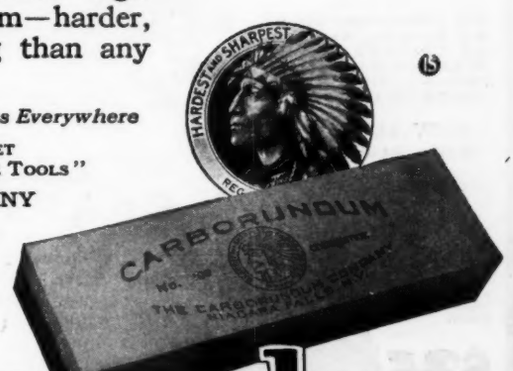
¶Made of Carborundum—harder, sharper, faster-cutting than any other material.

Carried by Hardware Dealers Everywhere

SEND FOR BOOKLET
"HOW TO SHARPEN EDGE TOOLS"

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
Canadian Carborundum Co., Ltd.
Niagara Falls, Ont.

(Carborundum is the Registered Trade Mark used by The Carborundum Company for Silicon Carbide and is its exclusive property)



Carborundum
REG. U. S. PAT. OFF.
ABRASIVE PRODUCTS

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SIMONDS

SAWS FILES KNIVES STEEL

CROSS-CUT SAWS THAT LESSEN LABOR

NO cross-cut saw, so far developed, cuts faster or holds its sharpness longer than a Simonds. Simonds Crescent-Ground Cross-Cut Saws built their reputation for excellence on the foundation of the highest grade of specially treated steel followed by the finest craftsmanship. The result is a saw that does its work faster, easier and more economically than other saws that often cost more.

Specify Simonds for Economy!

SIMONDS SAW AND STEEL CO.
Fitchburg, Mass.
"The Saw Makers" *Established 1832*
Branch Offices and Service Shops in Principal Cities

The Best $10.00 You Ever Spent

Only $10.00 Down
Your own terms on purchase $10.00 down. Liberal discount for cash.

Sent on 10-day FREE TRIAL
Use our shop for 10 days at our expense; if not satisfied, return express collect.

FREE BLUE PRINTS
Well designed blue prints on hundreds of furniture pieces and other wood handicraft, these are free with purchase.

SPECIAL CRAFTS COURSE ALSO FREE
Under personal supervision of Master Craftsman Eugene Maurey, our educational department offers courses in craftsmanship free to all shop owners.

Our Literature Gives All Details. Send to UP-TO-DATE MACH. WKS. 2915 So. Wabash Chicago, Ill. [USE CORNER COUPON]

NEW 12" Band Saw
Newly developed, of the latest design in Band Saw equipments, this 12-inch Band Saw is guaranteed vibrationless, and accurate in every detail. It is supplied with a tilting table, miter and side gauge.

$35

F.O.B. CHICAGO
May be purchased on time payment basis at $39.00, $10.00 down and $10.00 per month. With this plan anyone can own a real Band Saw.

GUARANTEE
If upon receipt of the Up-to-Date Home Craftsman Shop you are not satisfied, without question every cent refunded and return express charges paid.

THE UP-TO-DATE HOME CRAFTSMAN SHOP

Plug in on any light socket and go to work. Make your old work bench a modern Up-to-Date workshop. THE SHOP COMPLETE consists of a Super-power Motor, an accurate Lathe (10" x 34"), a 6" circular saw which features the bevel, miter side and depth gauges, a Tilting Table, Jig Saw, and all accessories for buffing, grinding, cleaning and all portable or stationary drilling and sawing.

MAIL THIS FOR FULL PARTICULARS TO
Up-to-Date Machine Works, Dept. 23
2915 S. Wabash Ave., Chicago, Ill.

Manager, Dept. 23. Without any obligation, please send me all particulars about your shop, 10-day free trial, free blueprints, free crafts course, also $10.00 down payment offer.

Name .....

Address .....

The Handy Man

(*Continued from page 88*)

Oh, I would find my Handy Men! I would find a dry-goods clerk sneaking up to the attic out of Second-Grade Mary's way, praying she won't discover him, because he loves her so much. And why? Doll's house! Two stories, with bathroom and cupola. Glazed windows cut with father's glass-cutter! Pilasters smoothed with father's little block plane! Green and white color-varnish flowed on from father's little brush! Real shingles on the little roof out of that extra piece of printed linoleum father saved. Got to get busy if it is to be ready for the Birthday.

Doll's house! You can buy them in the stores. But if you do, you commit sacrilege. A doll's house is holy when father makes it. He's twice the father, and Second-Grade Mary will never forget that little house if she lives to be ninety. What she always remembers is, "Father made it for me with his own hands." Handy Man!

Oh, keep on, brothers, even if you never get your diploma. Keep on making things and mending things with your own hands. Never mind if so-called "practical men" say you fiddle away your spare time and money. What do they do with their spare time and money?

And you women. Be human. Let your husband make a few shavings in the kitchen. Let him clamp his little vise on the table. Let the boy heat his soldering iron on the gas stove. If you don't, you're killing something divine which the Creator put into that man, and it must come out. Men can't bring forth babies. They can't be forever at their regular work. Let them be Handy Men—and fervently thank God if you've got one in your home.

Postscript.—Some happy day the good architects will do a new thing. Instead of marking that little 8 by 8 room, "Den" (you'd think a man was a bear), they'll mark it "Home Work-shop"! Why not?

Fastening Oversize Storm Sash

WHEN appearances are of no great importance, a ready-made storm sash often can be used, without any fitting, for a window not of a standard size. It is merely fastened on the outside of the casing as shown, by three or four screw eyes on each side and one in the center at top and bottom. In this way it is possible to use a sash that is 2 or 3 in. wider than the inside width of the window casing.—H. L. W.

Oversize storm sash held with screw eyes.

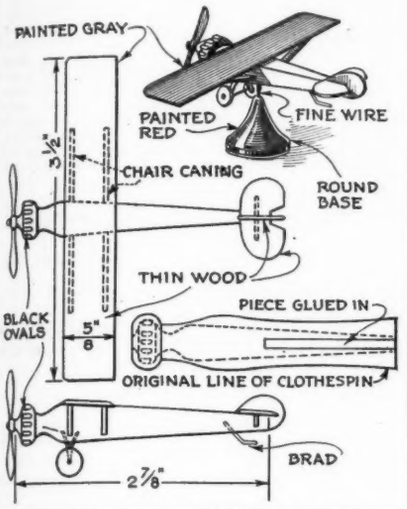
THE clogging of the throat of a plane usually is caused by the cap iron's being too thick or not fitting the face side of the cutter perfectly. Judicious filing of the upper and under sides of the cap iron with a flat file will remedy either trouble.

Model Airplane Has Clothespin Body

By F. Clarke Hughes

SMALL model airplanes are attractive novelties for use as ornaments, favors, or toys.

The body can be whittled from a spare piece of soft pine, or a clothespin may be used. A good length is 2¾ or 3 in. and the breadth and depth in proportion. The wings are best made from very thin,



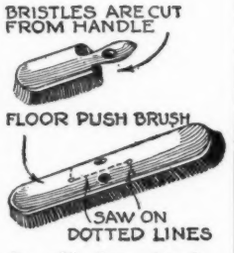
Top and side views and sketch of the plane; how the body is made from a clothespin.

soft pine. They are merely glued in place. The stays may be made from pine, reed (cane), or bamboo, such as that used in making flying models. The motor and propeller are carved with a pocketknife.

After the model has been lacquered a light gray, it may be placed on a small red base, such as the one illustrated, or suspended by means of a black silk thread from a chandelier or other support.

Cheaply Made Dust Brushes

TWO good dust brushes often can be made from a discarded floor push brush, provided the brush is not too badly worn. Saw it according to the accompanying diagram, trim away the hair on what are to be the handles, and dress the handles with a rasp or coarse file. While the handles are not centered, this does not matter.—FRED W. HARTON.



An old floor brush becomes two brushes.

Substitute for Rubber-Stamp Pad

A SUBSTITUTE for a rubber-stamp pad can be made by wrapping a length of typewriter ribbon around a piece of cardboard and fitting it into an old stamp pad box. When the pad no longer gives a clear impression, the outer layer of ribbon can be cut away.

"Just notice the fine skins of men who use WILLIAMS!"

The Cream that *leaves* FACES FIT!

The absolute purity that comes from triple distilled ingredients . . . . .

Eighty-eight years of specialized study in blending these ingredients . . . . .

These, among many other things, have put Williams Shaving Cream in a class by itself.

Have you tried it? *Yes, of course?* Then we don't need to tell *you* anything more about it.

And listen to the drug clerk. He has a chance to know. "Oh, yes, sometimes they change, ... *but they all come back to Williams!*"

The J. B. Williams Company, Glastonbury, Conn.—Montreal, Canada.

Next time say

"Williams Shaving Cream *please!*"

Afterwards find out how perfectly AQUA VELVA completes the shave.
Made *just* for that!

Where's the can of

PLASTIC WOOD?

[Reg. U. S. Pat. Off.]

A sail boat broken, a damaged toy—it's a real tragedy in child life. But Plastic Wood, which Handles like Putty, Hardens into Wood, and holds fast to wood, metal, fabric, plaster, porcelain or glass will quickly effect cures that would make a surgeon or magician green with envy. Keep it on hand for toy accidents—and use it for repairs of all kinds around the house; floor, baseboard and door cracks; loose casters, handles, and furniture; mouse holes, screw holes, nail holes; cracked tiles and porcelain bathroom fixtures.

PLASTIC WOOD

[Reg. U. S. Pat. Off.]

White Waterproof Tile Cement.

For the bathroom, when tile or porcelain splits, cracks open up around the tiles, or a wall fixture comes loose, Plastic Wood White Waterproof Tile Cement is of immediate value. It will hold broken pieces, seal cracks, is impervious to water, and dries to a hard flat white. At the same prices as Plastic Wood.

Plastic Wood Solvent.

Plastic Wood dries rapidly, and often when working it becomes necessary to soften or thin it. A few drops of Plastic Wood Solvent will renew the wood that has started to dry. Plastic Wood Solvent, in 25 and 50-cent cans, can be bought through your dealer.

Handles like Putty

Hardens into Wood

1 lb. can $1.00 ¼ lb. can 35 cts.

At Hardware and Paint Stores

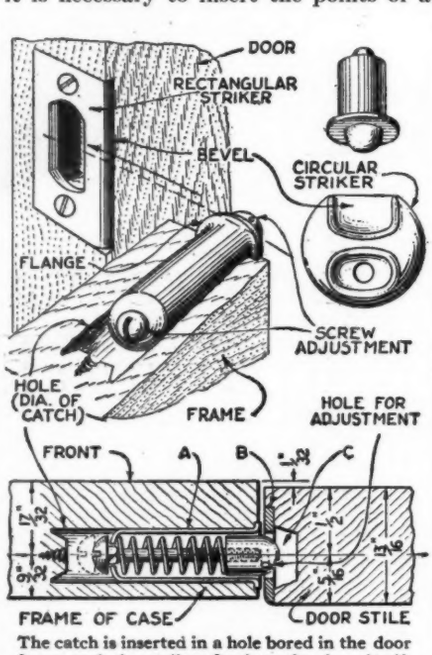
ADDISON-LESLIE COMPANY
309 Bolivar Street Canton, Mass.

Door Catches That Anyone Can Apply

THE home worker often desires to keep the door of a cabinet or cupboard closed without the use of a lock, a latch, or a surface catch of any kind. The best solution is to apply a friction catch, which is cheap, efficient, and, above all, easy to fit.

Ball friction catches usually range between ¼ and ½ in. in diameter and ½ and 1 in. in length. The size most commonly used for work about the house is ⅜ by ¾ in., for a catch of that size may be safely placed in a 13/16-in. rail or partition.

This type of catch may be purchased in almost any well-stocked hardware store. It is best to obtain the adjustable variety, if possible; then the ball may be screwed in or out to compensate for the shrinkage or swelling of the door. To turn the ball, it is necessary to insert the points of a pair of dividers in the slots or holes made for that purpose.



The catch is inserted in a hole bored in the door frame and the striker fixed to the door itself.

Fit and hang the door accurately, allowing for the "sinkage"—let us say 1/32 in. Then it is necessary to decide whether the catch is to be located in the top or bottom edge of the door about 1 in. from the lock edge, or in the lock edge of the door near the knob or pull.

If the face of the door twists out a little or is not perfectly straight at the top, the catch may be placed at the top; it will then hold the door straight unless it is too badly out of true. If the lower corner springs out when the door is closed, the catch should be placed there. If placed near the center of the lock edge, the shrinkage of the door may demand more frequent adjustment of the catch, but the door can be opened and closed more easily.

Locate the center of the catch about as indicated, the dimensions being intended to show only the relation between the ball and the front of the frame as compared with the center *(Continued on page 113)*

"Lava-clean" hands are clean!

Men—you who love to tinker—here's just the soap you need. Cleans quickly and thoroughly the toughest-looking pair of hands that ever fussed around a work bench. Makes more lather in 15 seconds than ordinary soap in 60, and even hard or cold water won't discourage it. Millions use it. "Good old Lava," they call it. Get hands *clean!* Not just "surface clean," but clean 'way down deep. As easy on your hands as fur-lined gloves—because it's made from the finest of vegetable oils. All grocers sell it.

Full size cake of Lava Soap FREE!

Mail this coupon

Procter & Gamble (Dept. X 1128)
Cincinnati, Ohio.

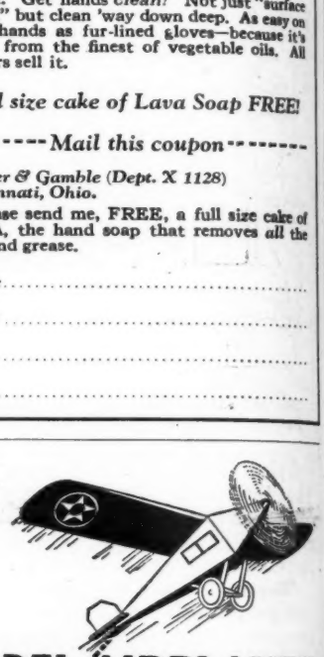
Please send me, FREE, a full size cake of LAVA, the hand soap that removes *all* the dirt and grease.

Name .....

Street .....

City .....

State .....



MODEL AIRPLANES

Ready to Fly

Designed like and look like real airplanes . . . the Spirit of St. Louis, The Bremen, The Fairchild and The Fokker. EVERY MODEL GUARANTEED A PERFECT FLIER. Will fly from 300 to 500 feet. And *strong!* Dropped from a real plane at 1200 feet, they made perfect landings without a scratch. All metal motor mount, sturdy wings, scientifically designed aluminum propeller; rubber-tired aluminum wheels and shock absorber landing gear. Get one now and win big contest prizes like other boys are doing. Packed in strong corrugated boxes, they come to you ready to fly. Tested at the factory and guaranteed to fly and land like the big planes. Scout model illustrated above, wing spread 20", sent you on receipt of $3.50. Order now and let the fun begin!

Catalog and Free Glider 10c

AMERICAN MODEL AIRCRAFT CO.
Dept. 2
New Haven, Conn.

Simplified Eye Splice for Ship Models

THERE are many places in a ship model—as in attaching deadeyes to the shrouds, fixing pendants to rigging blocks, and making eyes in the stays—where an eye splice would be useful, but owing to the small size of the majority of "ropes," a true eye splice would be impossible to make.

How realistic little splices may be made.

To make a simplified splice, the first thing is, of course, to fix its location. With a pointed "marlinespike" of wood or metal, open up one strand of the standing part after passing the running part around the deadeye or block. Pass the end under the open strand and pull it snug. Finish the splice with one or two more tucks, going over one strand of the standing part and under the next one, as in a regular splice.

Apply a little diluted glue, cut off the sea end when the glue is dry, and you will have a nice splice.

I have found that excellent results can be obtained by using shoemaker's black wax to "tar" all rigging before setting it up. The wax helps to stick lashings, knots, and splices in position and is a protection against moisture. Draw the lines over the wax.—W. E. PATRICK, Jr.

Catches Anyone Can Apply

(*Continued from page 112*)

of the striker socket and the face of the door. The dimensions will vary with the thickness of the door and frame and the surface sinkage of the door.

Bore the hole in the frame to receive the plug and drive the plug into the hole as at *A*. Close the door and work it back and forth a few times to mark upon the edge of the door the point where the center of the ball rests when the door is closed. A broad chalk mark made at this place to receive the track made by the ball will make the point show more definitely.

Place the striker plate on the door with its beveled edge facing the inside of the door as at *B*. Have the center of the striker socket coincide with the center point marked by the ball on the edge of the door.

Mark accurately around the striker with a sharp-pointed knife. With knife or chisel cut a recess to these lines so the face of the plate will fit closely, and of the depth to allow the striker plate to rest flush with the wood when fastened in place with screws. Cut away the wood under the striker socket to allow the ball to enter freely as at *C*.

If the frame of the door opening is not thick enough to receive the plug, it will be necessary to set it in the edge of the door. This is not so satisfactory as placing it in the frame.—CHARLES A. KING.

Now! The Encyclopaedia that Never Grows Old

When daring airmen bridge the continents in a few hours; a great flood sweeps the Mississippi Valley; a new treaty for world peace is made—when Medicine triumphs over previously incurable disease; or electrical energy performs new wonders—as oil heating for homes is perfected—*always* the FIRST permanent work of reference to fully record it is NELSON'S Perpetual Loose-Leaf Encyclopaedia.

The information which is obsolete is worse than none at all. You do not use a City Directory that is two years old. Why use an Encyclopaedia that is five or ten years old?

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Nelson's Encyclopaedia is the representative, authoritative American Encyclopaedia.

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The value of an encyclopaedia is dependent on its up-to-dateness. Because it is Loose Leaf and because the pages that keep Nelson's Encylopaedia up-to-date are supplied ready to be slipped into their proper place every six months, NELSON'S ENCYCLOPAEDIA NEVER GROWS OLD—*it lasts a lifetime.*

The importance of the *loose-leaf* feature of Nelson's Encyclopaedia is best illustrated by the fact that about 2000 changes are made yearly.

Think what this means to you—an Encyclopaedia to last a lifetime. Every encyclopaedia, except Nelson's, is out of date within six months after it is published. Nelson's *Loose-Leaf* Encyclopaedia is the only encyclopaedia that is always up-to-date. There are no "new editions" to buy—*it is always new!* The set you buy today will be as up-to-date ten, fifteen, or twenty years from now as the day you buy it.

Every one has felt that he would like to own an authoritative encyclopaedia — many have hesitated to make the investment knowing that encyclopaedias get "old" so quickly. But now you can buy a Nelson Encyclopaedia knowing that it will last you a lifetime and *always* be up to the minute. And you can buy a Nelson Encyclopaedia for surprisingly little money.

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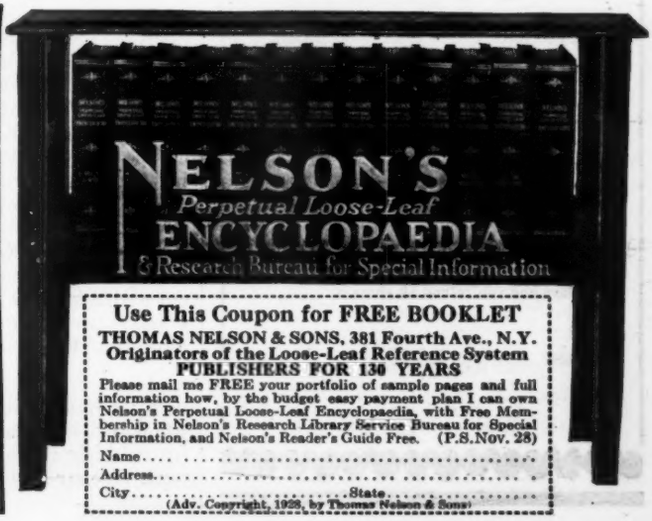

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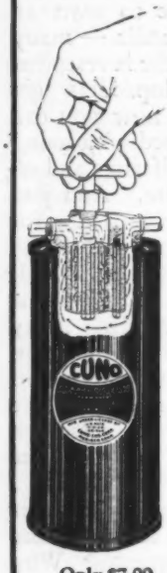
At Last Here Is a Permanent Oil Filter for Your Car

ALWAYS 100% EFFICIENT

The CUNO AUTO-KLEAN FILTER

Here is the final solution of your oil filter problems. Filters oil through a cartridge made of very thin washers and spacers, with cleaning blades. A turn of the cleaning handle rotates the cartridge which cleans the filter discs. Takes all dirt, lint, carbon and water from oil and deposits it in bottom of container. Easily drained.

The Cuno Auto-Klean filter replaces any existing oil filter system, operates on any pressure. The initial cost is the final cost. Takes only a few minutes to install. All fittings included.



Only $7.00 Complete

Clean oil makes your motor run better and last longer. Install a Cuno Auto-Klean now—it will never wear out or need replacement. Order one today on our positive guarantee of satisfaction. Use it thirty days. If you are not entirely satisfied we refund purchase price and delivery charges. It will save its cost many times over.

The Cuno Auto-Klean filter is a British invention used successfully all over the world for several years. We also make models for oil, gasoline or any fluid filtration—for autos, trucks, buses motor boats, vessels, Diesel engines, machinery, airplanes, etc. Write for full information on your requirements.

Some exclusive territory open for established distributors, Write

COUPON

The Cuno Engineering Corp., Dept. S-1
Meriden, Conn.

Please send me one Cuno Auto-Clean Oil Filter for: Car.....Year.....Model.....

I enclose $7.00 with the understanding that if I am not completely satisfied I may return this filter in thirty days and you refund all charges.

NAME.....

ADDRESS.....

.....

Ship Model Contest Aids Tuberculosis Work

Edward Thatcher with a Roman galley he built for the Tuberculosis Association.

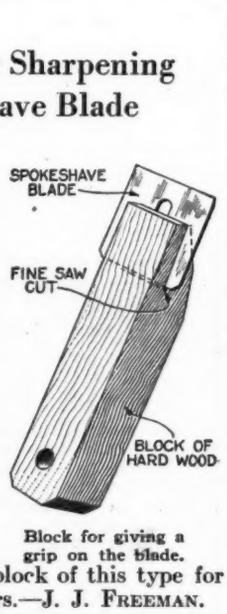
SHIP model builders now have an opportunity to compete for prizes in a series of local or state contests being conducted to aid the work of the National Tuberculosis Association. The model must be a Phoenician, Greek, or Roman ship resembling the argosy that is pictured on the Association's 1928 Christmas seals.

Edward Thatcher, who is a regular contributor to the Home Workshop Department of POPULAR SCIENCE MONTHLY and a distinguished American craftsman, constructed for the Tuberculosis Association a Roman galley of the general type desired in all the competitions. He also prepared an illustrated booklet telling how to build one like it.

Readers who have successfully constructed POPULAR SCIENCE MONTHLY ship models and have thereby gained valuable experience in this fascinating work will be well equipped to enter the contests. They can obtain a copy of Mr. Thatcher's booklet and the contest rules from their state or local Tuberculosis Association.

Holder for Sharpening Spokeshave Blade

SHARPENING a spokeshave blade is a problem that often gives the home worker some difficulty. That is mainly because a blade is so hard to hold. A good holder, however, can be easily made from a block of wood as shown. The blade must fit tightly in the slot, which should be cut with a fine saw.



Block for giving a grip on the blade.

I have used one block of this type for more than fifty years.—J. J. FREEMAN.

FINGER spots and other marks on painted woodwork and walls often can be removed by rubbing them with a rag moistened with vinegar and dipped in baking soda.

Stop that leak in your roof

BEFORE it causes costly damage stop it with Rutland No-Tar-In Roof Coating. No trouble at all to apply, costs little and makes leaky roofs as good as new.

Rutland No-Tar-In provides a perfect coat of asphalt and asbestos—*a tough mineral covering.* Not a drop of tar in it. It will not crawl, sag, harden, peel or blister. For every kind of roof (except shingles).

Insist on Rutland at your hardware or paint store. If your dealer hasn't it, mail coupon below. Rutland Fire Clay Co., Dept R-26, Rutland, Vermont. *Also makers of Rutland Patching Plaster.*

Rutland
No-Tar-In
ROOF COATING

RUTLAND FIRE CLAY CO.
Dept. R-25, Rutland, Vermont.
Send me more information about No-Tar-In.

Name.....
Address.....
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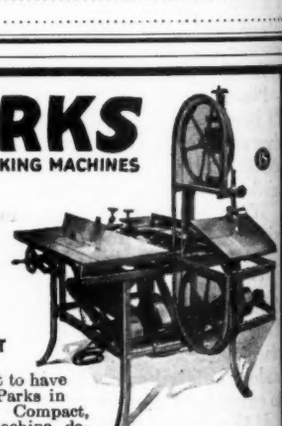
PARKS
WOODWORKING MACHINES

Cabinet Shop Special No. 10 $290 with Motor



You ought to have this handy Parks in your shop. Compact, complete machine designed like a big production outfit at 1/5 the cost. Fits in a corner of your basement. Does any kind of cabinet or joinery work. *Write for circular.*

The Parks Woodworking Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 308 Notre Dame East, Montreal

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

WHEN wood with knots in it is used for building purposes, as frequently must be done, the knots often fall out. Such holes are best repaired by means of a plug of softer wood cut to a size slightly larger than the hole and having a minute taper. Roughen the inner surface of the hole with a rasp and force the plug in position. If necessary, hardwood wedges may be forced into the soft wood plug to make it still firmer.

Casein glue (purchased at a paint or hardware store in the form of a white powder and often called "milk" or "airplane" glue) may be used to fasten the plug in position. Then, too, the knot itself may be glued in place with casein, but it seldom fits tightly enough.

Small holes may be filled entirely with a casein cement, made from the prepared

Casein for use in making waterproof cement can be precipitated by adding acid to milk.

commercial casein glue or prepared at home by precipitating casein from skim milk by the addition of a little vinegar or acetic acid—merely sufficient to coagulate the casein. This is then washed with water and dried in the air. The particles are broken up and slightly heated to drive off all moisture. Then the casein is powdered and mixed with burnt and powdered lime (calcium oxide).

For every part of casein by weight, take one part of powdered lime. Keep the powdered mixture in a bottle and moisten it with water just before using.

A number of water-resisting cements are known, and some of the better types may be briefly described as follows: Mix about equal parts of fresh casein, plaster of Paris, and red lead, or mix rye flour with freshly slaked lime, or cement with waterglass; or use carpenter's glue dissolved in water to which Portland cement is added until the consistency is satisfactory for use. This material hardens in a few days. If desired, one or two parts of sand may be added to give more body. Use this cement as soon as made.

Another useful cement consists of three parts of rosin mixed with one of beeswax. The rosin is melted and the wax added. This cement must be used hot, but it can be remelted at any time. It is a good cement for knife handles and is waterproof.—E. BADE.

Beard Tough... Skin Tender? *Forget it Men!*

Whiskers come off quick and smooth when beards are softened small-bubble way. No razor-pull, sting, or smart. Read how this new-type lather takes razor-pull out of shaving. See our no-cost offer in coupon below.

"Yas . . . Boss! Small bubbles sure get whiskers off quick. That's what most of my gentlemen ask for."

DOES the above headline surprise you? Are you one of those men who believe that shaving, at best, must always be uncomfortable . . . that razor-pull, sting and smart can never be completely done away with?

If so, you'll find lots of good news in this advertisement. It's the story of a new, quick way to get your whiskers off. A way that's faster . . . cleaner . . . smoother than any you've ever known before.

You'll discover the difference the minute you try it. You'll see it in your mirror. Instantly your face feels serene and comfortable . . . delightfully fresh and clean.

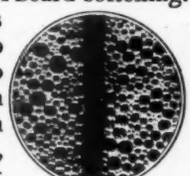
How it works

No other shaving cream is like Colgate's. No other can offer you such unique results.

It is, we believe, the ultimate attainment in the science of beard-softening.

Colgate lather is designed to absorb more water . . . to scientifically drench your beard with moisture at the base, where the razor work is done.

It's a "small-bubble" lather. For small bubbles hold more water. They carry it closer to the base of your beard.



Ordinary Lather

Photomicrograph of lather of an ordinary shaving cream surrounding single hair. Large dark spots are air—white areas are water. Note how the large bubbles hold air instead of water against the beard.

Colgate Lather

Photomicrograph prepared under identical conditions shows fine, closely knit texture of Colgate's Rapid Shave Cream lather. Note how the small bubbles hold water instead of air close against the beard.

That's the principle, men. Now here's what it does for you:

1. The soap in the lather breaks up the oil film that surrounds each tiny hair . . . floats it quickly away.

2. Then billions of tiny, moisture-laden bubbles seep down through your beard . . . crowd close around each whisker . . . soaking it soft with water.

Instantly your beard gets moist and pliable . . . limp and lifeless . . . scientifically softened right down to the base . . . ready for the razor.

Thus your whiskers come off clean and smooth. We will gladly send a seven-day trial tube. Also a sample of "After Shave," our new-type lotion.

Colgate & Co., Dept. 500-K FREE OFFER MEN!
595 Fifth Ave., New York

Please send me FREE sample of Colgate's Rapid Shave Cream. Also sample of Colgate's After Shave.

Name_____

Address_____

Tourist Leaves Tin of Favorite Tobacco as Calling Card

Travelers since time immemorial have left an endless variety of messages behind them in places they have visited.

Here's a tourist who tells the story of a totally different type of message. It brought what seems to be a record reply:

Calgary, Alta.,
March 4, 1928

Larus & Bro. Co.,
Richmond, Va.,
U. S. A.

Gentlemen:

While in Banff, Alberta, in 1909, I climbed Tunnell Mountain. On top of this mountain there is a cairn of stones where tourists leave their cards with remarks about the scenery, etc. Not having a card with me, I left a tin of Edgeworth Sliced, scribbled my name and address on a piece of paper, and said "Have a fill on me."

I have kept up a haphasard correspondence with one of three who wrote me thanking me for the Pipeful of Edgeworth. What makes me write you is that today from Australia I received two slices of Edgeworth with the words, "Have a fill on me," so you see Edgeworth keeps friends friendly.

Yours sincerely,

P. B. Johnstone.

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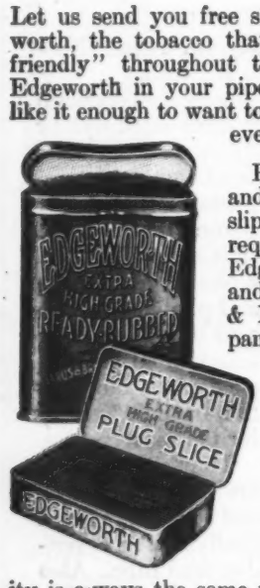

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If you *do* like this tobacco, you can be sure you'll keep on liking it, because its quality is always the same no matter where or when you buy it.

When you want to buy Edgeworth you will find Edgeworth Ready-Rubbed and Edgeworth Plug Slice on sale everywhere in small packages which can be conveniently carried in the pocket, and in various other sizes up to the handsome one pound humidor.

On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length 254.1 meters. Frequency 1180 kilocycles

How to Build Small Corner Cabinet

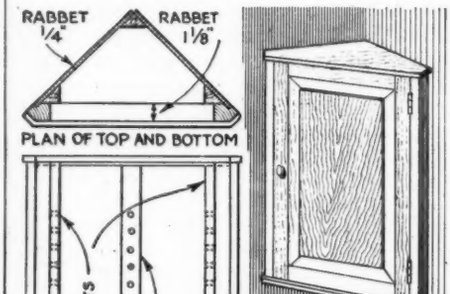
By A. E. Elling

IN EVEN the smallest bathroom there is room for a corner cabinet of the type illustrated below. It requires only a 9 by 18 in. space on each wall in the corner.

The same method of construction may be used, of course, for larger cabinets. While common soft woods, painted or enameled, serve for a bathroom, highly finished cabinet hardwoods would be appropriate if the cabinet were to be placed in a bedroom or living room.

Top and bottom are alike—a right-angle triangle of ⅞-in. thick wood measuring 9 in. on the wall sides, without deducting the small corners cut off at right angles to the walls, which measure ¾ in. on the face. The front, with corners uncut, measures about 12¾ in.

Cut a rabbet (long recess) out along the wall edges of both top and bottom, ¼ in. on the face and ⅜ in. on the edge.



Plan and front views without the door, a sectional detail, and the completed cabinet.

A triangular piece, measuring 1⅛ in. on the hypotenuse or face, must be also cut out on the wall corner on both top and bottom to a depth of ⅜ in.; this is to receive the triangular back post. Rabbet the front of each piece ⅜ in. on the edge but 1⅛ in. on the face.

If one is not accustomed to the use of the rabbet or fillister plane, the rabbets in the top and bottom and also in the posts may be cut out with a backsaw. Tack on a thin strip of wood, if you wish, as a guide for the saw. Only the front rabbets of top and bottom need to be cleaned with sandpaper.

Make three pieces each measuring ⅞ by 1⅛ by 17 in. Shape two of these to form the corner posts and the third to form the back post, the latter with a 1⅛ in. face. Cut two triangular pieces ¾ in. on each angle and 16¼ in. long. These form stops for the door and also carry the shelf pins. Both *(Continued on page 117)*

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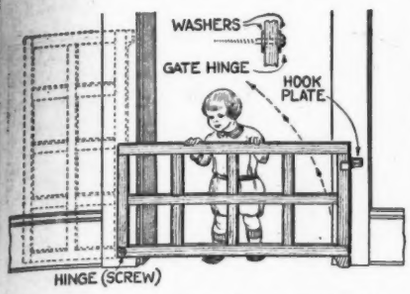
A definite program for getting ahead financially will be found on page four of this issue.

One Screw Acts as Hinge for Hanging Baby's Gate



Little damage is done to the woodwork when a gate is hung by this simple method.

HOW to fasten a baby's gate temporarily to a door or a porch railing without unnecessarily damaging the woodwork or going to too much trouble, is a problem that is frequently encountered. One simple solution is that shown above. The gate is pivoted on a long wood screw in such a way that it can be instantly tipped up out of the way. The catch can be made of metal or cut from a block of hardwood.—FRANK M. DUGAN.

How to Build Corner Cabinet

(Continued from page 116)

stops and back post should be bored with holes about 1 in. apart to suit small shelf pins. Leave at least 3 in. unbored at top and bottom. Bore all exactly alike.

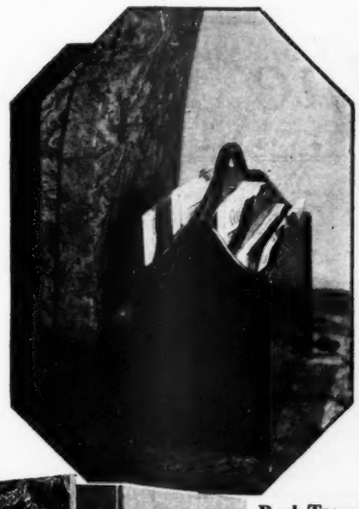
To assemble, apply good liquid glue lightly to the rabbet of one post and to the edge of a piece of wall board, which should be the same length as the posts (17 in.) and, if the rabbet is as shown in the accompanying drawing, 7¾ in. wide. The edges of the wall board should be cut parallel and square. Use short brads to fasten the wall board to the post. Repeat the operation with the other corner post.

It will help in attaching these parts to the back post to nail a piece of board about 5½ in. wide on its edge on the bench. Upon this place the back post, face down. Then nail on the wall board from both sides, after applying glue. If both sides are the same width, they will not overlap.

The top and bottom are now bradded to the posts and the stops are glued in place. Fit a piece of cardboard loosely inside the case as a pattern from which to make two or three glass shelves. Double thick window glass is heavy enough, although plate glass is better. By rubbing the front edge of the shelves on a hard stone with some wet sand on it, the sharp corners may be ground off.

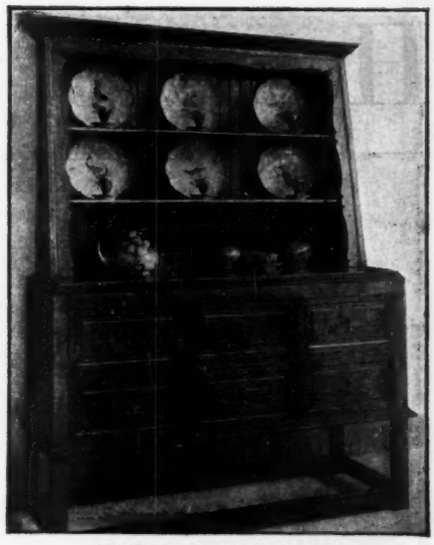
The door may be made as shown, with a raised panel, or a plain panel of wall board can be used if the case is to be painted. Another method is to rabbet the door stock instead of grooving it. This permits the use of a mirror.

The stiles and top rail of a door of this width should not be more than 1½ in. wide, and the bottom rail 2 in. They will be ⅞ in. thick to come flush with the face of the posts. Mortised and tenoned or doweled joints can be used. Hang the door with small butt hinges and add a glass knob and a friction ball catch.



Book Trough and Magazine Stand
See LePage's Book, page 19

Modernistic Folding Screen
See LePage's Book, page 12



Old Salem Ship's Cupboard
See LePage's Book, page 5

How to make your own Household Furniture

LePage's Latest Book Shows How —for Yourself; for Christmas Gifts

LePage's latest book, the new "Third Home Work Shop Book," contains complete, easy-to-follow directions for making 20 attractive pieces of household furniture, of which, 17 are entirely new and never offered before.

This year the designs are divided into three groups. One group is based on famous old colonial pieces. Another group follows the furniture in popular demand for American homes of today. The third group is known as modernistic furniture, showing the influence of the modern skyscraper set-back architecture of New York City. To buy 20 such pieces would cost about $1,000. You can make them for a fraction of that, yet be the owner of truly fine furniture.

Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the directions for making it are perfectly practical.

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple easy-to-follow, step-by-step directions.

In addition to the three pieces shown above, the book includes the following: Cape Cod Chest of Drawers, Alexandria Nest of Tables, Lady Washington Sewing Cabinet, Modernistic Book Shelves, Desk, Table, and Fire Screen, Smoking Table, Caned Side Chair, China or Book Cabinet, Magazine Carrier, Vanity Case, Book Stand, Fernery Stand, Folding Sewing Screen, Plymouth Built-In China Closet, and Chess and Checkers Table. Where else could you get complete directions for making all these for only 10 cents?

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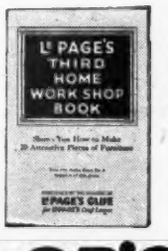
21 Tea Wagon
22 Telephone Cabinet
23 Stool for Telephone Cabinet
24 Manual Training Work Bench
25 Home Worker's Tool Cabinet
26 Spanish Galleon
27 Vanity Table



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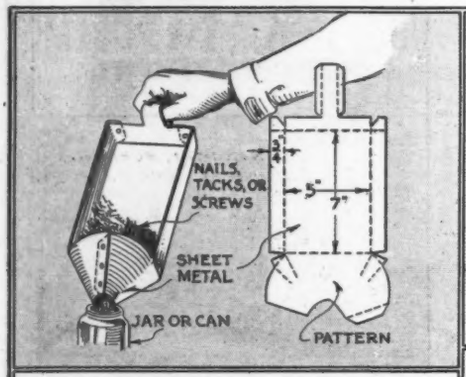
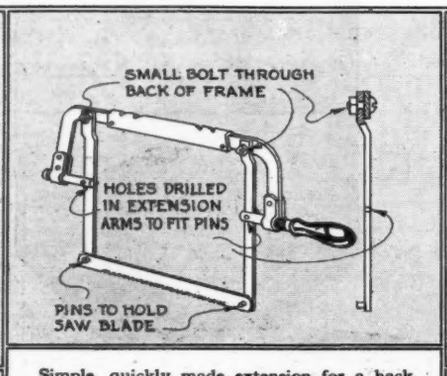
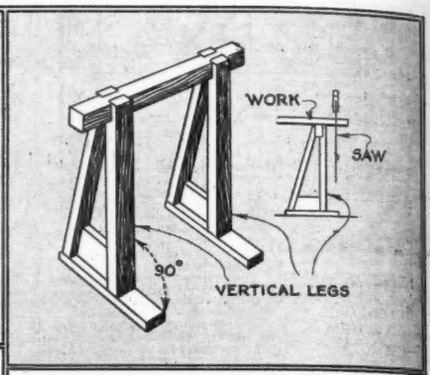
Helps *for the* Home Mechanic



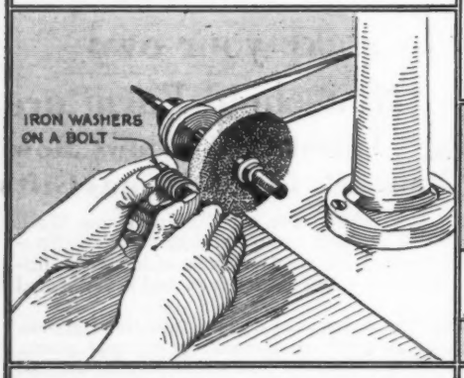
Sorting tray with funnel-like spout for pouring contents into a jar, tin, or other receptacle.



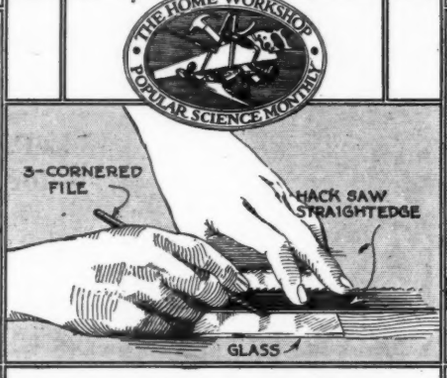
Simple, quickly made extension for a hack saw frame to allow large work to be sawed.



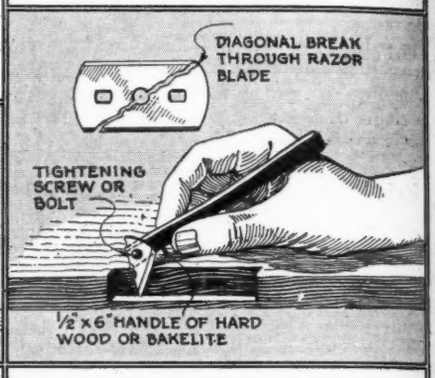
With two of its legs vertical instead of slanting, this sawhorse makes sawing easier.



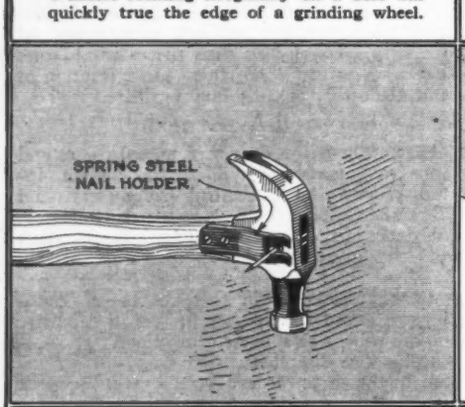
Washers rotating irregularly on a bolt will quickly true the edge of a grinding wheel.



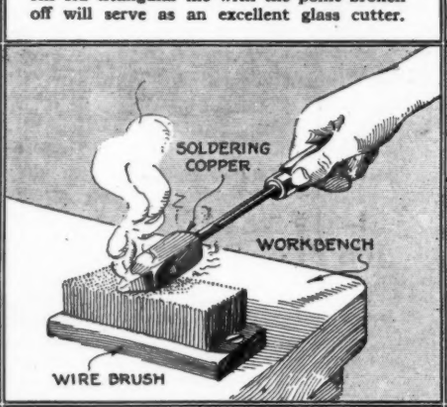
An old triangular file with the point broken off will serve as an excellent glass cutter.



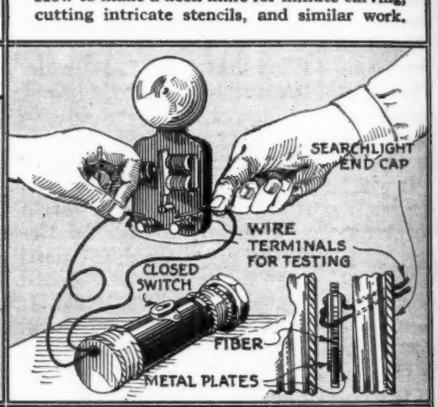
How to make a keen knife for minute carving, cutting intricate stencils, and similar work.



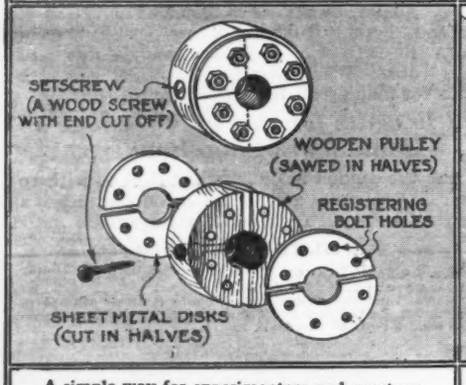
Hammer with homemade attachment to aid in starting nails and tacks in awkward places.



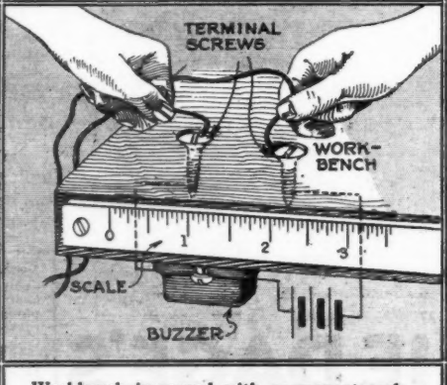
Wire scratch brush screwed to a bench top or to a shelf for cleaning a soldering copper.



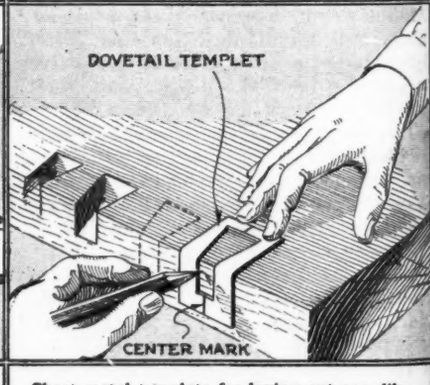
Searchlight temporarily converted into testing outfit for hunting trouble in electric wiring.


SETSCREW (A WOOD SCREW WITH END CUT OFF)
WOODEN PULLEY (SAWED IN HALVES)
REGISTERING BOLT HOLES
SHEET METAL DISKS (CUT IN HALVES)

A simple way for experimenters and amateur mechanics to make small split wooden pulleys.



Workbench improved with permanent scale and buzzer outfit for testing electric circuits.



Sheet metal template for laying out speedily both the faces and the ends of dovetails.

Puttying Windows

(Continued from page 94)

While this putty is also used for steel sash and gives first class results, red lead is considered even better. It is mixed with dry whiting or dry white lead in the same way as the white lead putty. It may be colored dark with dry lampblack, raw umber, or other dry colors.

For puttying sash you will need, besides a putty knife, either an old wood chisel for working on wood sash, or a steel wire brush (Fig. 1) for cleaning steel sash. Steel wool and No. 1 sandpaper are also useful on rusty steel sash. For the actual painting, you will require a round or oval sash brush (Fig. 2) or a flat sash brush about 2 in. wide. Some sort of brush for dusting is needed.

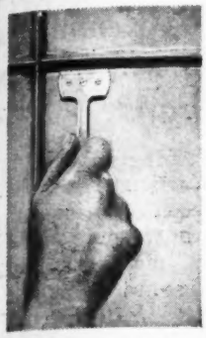


Fig. 4. Razor blade in special handle for cutting off dry paint.

The preparation of wood sash requires the removal of all loose putty and the application of a coat of paint wherever the putty has come away. In working on steel sash, scrape off all loose paint with a putty knife or steel wool, and remove the rust with the steel wire brush and sandpaper or steel wool. Liquid paint remover also can be used to advantage when considerable paint must be taken off, as in cases where the inside of steel sash has been painted with flat wall paint without a proper priming coat.

The first coat on the bare metal of steel sash, always should be red lead and linseed oil, ready-mixed iron oxide metal paint, or other rust-inhibitive metal paint. Then the second and third coats may be any first-class paints such as are used for wood.

It is especially important to use rust-inhibitive paints for the first coat on metal sash in kitchens, bathrooms, basements, and rooms where moisture is present.

In double hung (sliding) windows there probably is only one rule that is generally followed by painters: the sash bars are painted first. After that the stiles (side-pieces) and the top and bottom rails are painted. The windows are usually painted while closed, no attention being paid to the surfaces covered up, such as the check rail in the center. The runways generally are not painted, except the runway below the upper sash. When the sashes are moved much, the runways are oiled with boiled linseed oil.

Casement windows, which swing out or in, should be opened and all edges painted. Then the sash bars are done and finally the face of the sash. While the sash is open, the window frame is painted. It is best to allow the windows to remain open while the paint is drying.

Whether one is painting windows, doors, wood wall panels, or furniture, it is usually best to do the center parts first, then the molded edges, and finally the flat surfaces.

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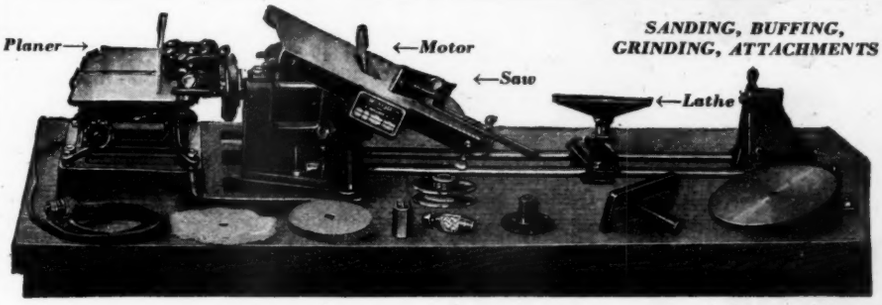

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Two Cubical Puzzles

(*Continued from page 92*)

laid (Fig. 4). H and E are placed back to back and fitted between B B so that the lower ½-in. cut on H binds C G (Fig. 5). A tier of blocks D G G D is laid on this combination (Fig. 6). The block F is slid over G from the side so that its middle projection fills the ½-in. cut of H (Fig. 7). The two blocks A A are placed as in Fig. 8. Another E block is put down through the vertical slot and pushed into place, its ½-in. cut engaging the ends of G G as shown by the first E block in Figs. 6, 7, 8 and 9. The final operation (Fig. 9) is to fit D into I and push the combination home.

The second puzzle is assembled somewhat differently. It is composed also of sixteen blocks: B B B B D D E E F F J J J K K L. K is taken first (Fig. 11) and two B blocks are fitted into it (Fig. 12). On K the block J is laid (Fig. 13). Another combination exactly like this is put together, turned over, and placed on the first (Fig. 13). This entire combination is bound together by two F blocks, which, when placed in the vertical slots, have their projections abutting and their ½-in. cuts engaging K J J K. One is shown in place (Fig. 14) and the other about to be inserted. One D block is placed on each side of F F (Fig. 15) after which the two J blocks are pushed in about ¼ in. to allow for the insertion of E J, placed back to back. It is best to insert E first with its central cut engaging the ends of J J, and then the J block (Fig. 15). E J and J J can now be pushed back into place, and another E block is put through the slot engaging J J (Fig. 16). Then insert key block L.

These two combinations embody principles useful in different arrangements.

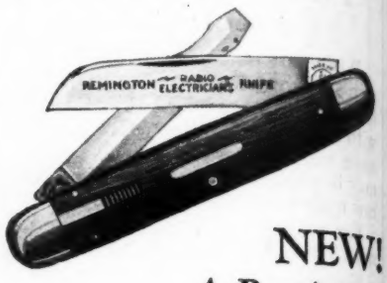
If a series of these blocks is given to a solver, it is possible for him to tell by inspection whether there will be internal spaces or not, as with the Chinese cross. The cubical contents of the assembled puzzle equal 512 small cubes measuring each way half the width of the ½-in. blocks. The cubical contents of the individual blocks composing it, if solid, would be 672. The difference is 160. This represents the amount of the material to be cut away. Hence the numerical value of the blocks must sum up to 160. If greater, there is internal space; if less, the puzzle cannot be assembled.

Ball Feet for Trays

RECENTLY I made several ash trays and other novelties from unserviceable radiator caps, using three ⅝-in. steel balls for the feet of each.

First determine the location of the feet, dividing the distance between them evenly, and drill ¼-in. holes clear through the base. Countersink the holes slightly on the inside. With a soldering iron, tin each hole on the inside. Lay a steel ball where it will not roll when touched and tin a spot about ¼ in. in diameter on top. Place one of the holes over this spot and spread the solder well around the inside edge of the hole and over the tinned area on the ball, filling the hole level with solder.—SHERWOOD J. GEE.

KNIFE No. R4548



NEW!

A Remington Knife for Electricians and Radio Fans . . .

THIS new Remington knife is just what electricians and radio tinkers have been waiting for. Can't be beat for scraping insulation from wires, making connections, tightening up, doing odd jobs. Has one 3-inch sheepfoot blade, and a 2½-inch screw-driver. The blade is forged from high carbon steel, razor sharp, and holds its edge a long time. One side of the screw-driver is ground to a cutting edge. Safety catch prevents screw-driver from closing when in use. Nickel silver bolsters, brass linings.

Ask your dealer to show you the Remington Radio Electrician's Knife. Note its hard, handsome, cocobolo handle. Test its razor-sharp blade. Note the screw-driver . . . see how strong it is. Knife No. R4548 is a wonderful value for $2.00. If your dealer hasn't it in stock, send us his name and the price. The knife will be forwarded at once, postpaid.

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Originators of Kleanbore Ammunition
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Remington

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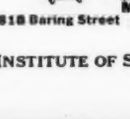
Sport Bodies for Fords
at FACTORY PRICES

This Model in Grey Prime **$38.50**

Write for Booklet A-10 Showing This and Other Models

SPORT FACTORIES, Aurora, Illinois

A SHIP MODEL FOR $4.98

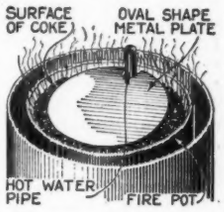


The World's Largest Builders of Ship Models will supply you with all necessary parts, cut to fit and ready to assemble, so you can build a beautiful model of the historic Santa Maria, La Pinta or Mayflower for $4.98 plus a few cents postage. No tools are needed except a small hammer. Full directions with each kit. Parts for the Constitution (Old Ironsides) may be had for $6.98 plus postage. Send for our beautifully illustrated catalog. No obligation.

MINIATURE SHIP MODELS, Inc.
3818 Baring Street Dept. O.O. Phila., Pa.

Uses Metal Cover to Bank Fire in Heating Plant

MY HOUSE is a warmly built six-room cottage. A hot water system using by-product coke furnishes the heat. Six or seven years ago I adopted the plan of banking the fire at night with ashes. Then the thought came that a metal cover might be the best thing to use, since it would possess all the good qualities of the ashes and none of the bad ones. Going to a tin shop, I had a sheet iron cover made as large as could be pushed diagonally through the feed door. The shape of this cover was slightly oval. When in use it would nearly touch the boiler at the back and in front, while at both sides there was an uncovered space of about two inches. That cover burned out the first winter, but the next year I had several covers made of heavier material, which I have used every year since.



Cutaway view showing the cover in place.

We aim to keep the house heated at about the same temperature during the night as during the day, so, after finding that the plan worked well at night, I adopted it for day use also. During the winter weather, we find the temperature of the living room when we get up in the morning very nearly seventy degrees. I open the drafts, run an iron bar through the clinker door, and slide it along over the grate to dispose of the surplus ashes, throw in a large shovelful of coke, partly close the draft, and leave it that way for half an hour or more. Then I fill the firepot nearly to the bottom of the feed door and put on the cover. All doors, slides, and other openings are closed except the check damper at the top of the boiler, which is left slightly open. Under ordinary conditions the fire needs no further attention whatever until about eight or nine o'clock at night, at which time I go through the same procedure.

Coke has its volatile gases so removed that but little remains except pure carbon. With six inches of live coals on the grate, I can fill the boiler with this fuel, put on the cover at once, and shut off the drafts with no danger of explosion. Anyone trying this plan with any other kind of fuel would probably have to let the gases burn off, more or less, before placing the cover.—C. L. HILL.

Oil Rubbing Furniture

(*Continued from page 90*)

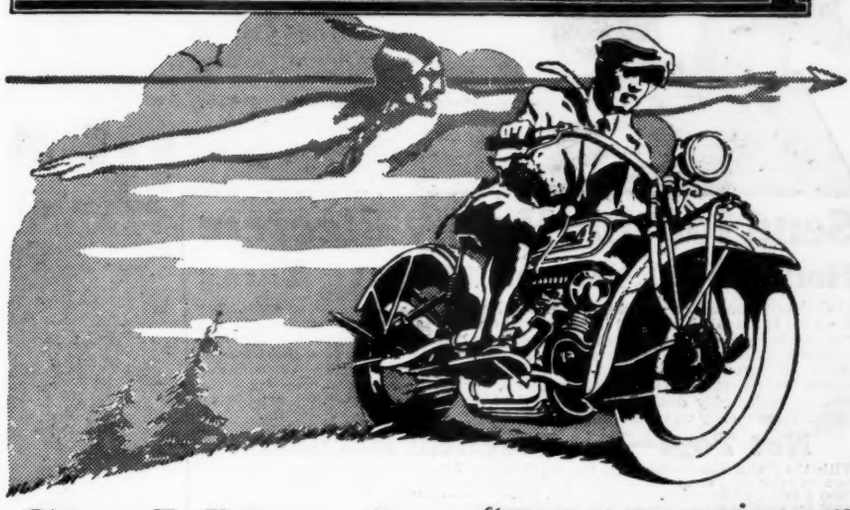
wood matches the old and the entire piece has been well oiled, polishing can be started. Use any good grade of floor wax. Apply it with cotton cloth that has been washed and is perfectly free from lint. Rub the wax back and forth across the grain or use a circular movement. Continue rubbing until the wax has been rubbed in and both the surface and the cloth are almost dry. Apply more wax and repeat the rubbing. Continue until the grain of the wood is thoroughly filled.

Let the piece stand until the turpentine in the wax has evaporated and then give a final polish. A good rubber for this purpose may be made from a piece of wood 2 by 2 by 8 in., padded on one side and over all of the face edges with a layer of cotton from ¼ to ½ in. thick, and covered with strong cloth. Tack the cover to the block halfway up the edges and ends. Place over the rubber a loose cloth.

You will find the rubbing is strenuous exercise, but the result will be a polish to delight those who appreciate a beautiful patina.

In his next article, the seventh, Mr. Stanley will give more pointers on finishes.

The NEW Indian 4



Give It Your Own "ROAD TEST"

Smooth, silent, quick on the pick-up, and quickly stopped. Here's an entirely new motorcycling sensation

Go to your dealer's, he'll let you take the new *Indian 4* for a spin. Give it your own "Road Test".

Take one of the old familiar runs and just compare the performance and pleasure with any motor you have ever ridden. Give it a little more gas on the last fifty feet of that long hill and the surge of power that sends you over the top will make your sporting blood tingle.

See how smoothly you take the sharpest curves.—Low saddle position and weight close to the ground.

Braking power will be a revelation. You can stop quickly and smoothly. Added safety.

Try traffic for a few minutes. Easy to "lock-out" the clutch when you stop. Spring clutch foot pedal.

Sound the horn. That's a real horn, too. Pierces the air with a clear vibrating note.

Stop by the roadside and look at the improved construction. Strong, compact, and every part that should be accessible *is* accessible.

We'll be glad to send you by mail a handsome folder showing the new *Indian 4* — every improvement is pictured and every feature is fully described.

Indian
Motocycle Company
SPRINGFIELD, Massachusetts

P.S.M. 11-28
Name..... Age.....
Address.....
City..... State.....
Send folder on the new *Indian 4*, please. Also give name of nearest Indian dealer.
.....(check only if unknown to you.)

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Send for this Husky *Electric* Home Workshop on 10 DAYS' TRIAL

Mail the coupon below—learn how you can have this big complete Delta Handi-Shop for **10 Days' Trial** right in your own home. Test it to your heart's content! Note its many exclusive features. See how this sturdy man-size machinery stands up under actual working conditions. Note how convenient is the ***two-shaft*** motor that enables you to handle two or three jobs at one time without dismantling set-up. See what wonders in craftsmanship, woodturning, carpentry are possible with this efficiently designed outfit. Make the things you've always wanted to make. Save money on repair work. Earn money in your spare time.

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With the Delta Handi-Shop you can do anything from building full-sized furniture, turning table legs, to carving delicate little wood decorations. You will find the Handi-Shop a real worker's shop, COMPLETE, FULL-SIZED, including all necessary equipment for woodturning, face turning, circular sawing, scroll-saw work, sanding, drilling, dado and joining work, grinding, buffing, tool-sharpening, and carving. And you'll be surprised at the low cost. The Handi-Shop gives you ***the utmost in actual machine value per dollar!***

Many Exclusive Delta Features

A few of them are: 1. Powerful, constant-speed, ***two-shaft*** motor designed to handle two or three operations at same time. 2. Heavy U-shaped lathe bed guaranteed not to spring or chatter. 3. Improved circular saw with exclusive tilting table features and extension guides. 4. Improved sanding disc with special tilting table (can be operated without detaching saw). 5. Improved scroll saw with special tilting table. 6. Automatically-oiled bronze bearings. 7. Highest grade equipment and materials throughout. 8. Completely assembled on heavy veneered wood base.

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Beautiful sparkling blue white Diamonds, set in solid 18-k white gold mountings, artistically designed and engraved. Complete variety! Buy from the old reliable House of Loftis, jewelers for 70 years—we are direct importers and save you all middlemen's profits. Jewelry, watches, silverware, and gift articles at lowest prices—order today!

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No. 898—Modern watch. Paris triple. 15-jewel movement, chromium finish case $17.50. $1.75 Down and $1.75 a Month.

Railroad Watches—Guaranteed to Pass Inspection

Hamilton No. 992, 21 Jewels. Adjusted to 5 positions. Gold filled 25-Year Quality Case . $55

Elgin's Latest Raymond, 21 Jewels, 7 Adjustments, runs 40 hours once winding. Gold filled 25-Year Quality Case. "Lindbergh" "Ocean Special," 21 Jewels, Adjusted to 6 positions. Gold filled 25-Year Quality Case . $50

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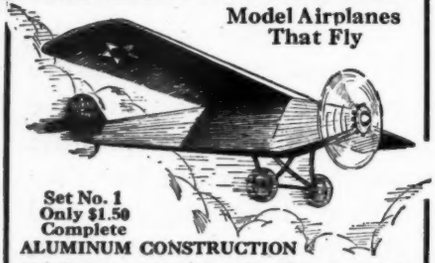
The MOCAR

Model Airplanes That Fly



Set No. 1 Only $1.50 Complete

ALUMINUM CONSTRUCTION

BOYS at last, here is a genuine aluminum model airplane that **really flies.** And at a small price. The "Mocar" monoplane—Set No. 1—is a copy of the famous Spirit of St. Louis. Wing spread 18 in., fuselage 12 in., powerful motor, ball-bearing propeller, rubber-tired disc wheels. Weight complete only about 2½ oz.

This is a practical, simple, real model plane that gives you a whole lot of fun for the moderate cost. The all-metal construction makes a sturdy plane that will stand a lot of abuse. The outfit is mounted on cardboard with all parts plainly marked, and full instructions for assembly. Pliers only tool necessary. Complete with rivets, bolts, wheels, wing and fuselage covering material, only $1.50 postpaid. (3 for $4.00.) **Order now.**

Great fun, learn how to make and fly airplanes.

Jobbers, dealers and schools write for discounts.

The illustration below shows the easy method of assembly. The illustration above, actual cut of finished plane

The Mount Carmel Mfg. Co.

Dept. S, Mount Carmel, Conn.

Making Arbors Is Useful Task in School Shops

Practice in turning work accurately to dimensions is afforded by this simple project.

MAKING an arbor is a school shop project that involves the use of micrometers in turning to accurate dimensions. Arbors of other sizes than that illustrated may be made.

The material is soft steel. The tools needed are: Hack saw, scriber, hammer, center punch, combination center drill, lathe dog, engine lathe, 6-in. steel rule, file, and 1-in. micrometer calipers. The operations: 1. Cut off a piece of stock 5 in. long. 2. Lay out and center ends. 3. Face off ends true on centers. 4. Turn $\frac{5}{16}$-in. diameters. 5. File flat spots on $\frac{5}{16}$-in. diameters. 6. Rough turn $\frac{3}{8}$-in. diameter. 7. Finish turn $\frac{3}{8}$-in. diameter accurately.

Some arbors are made from tool steel. These are turned .010 in. oversize, then hardened and tempered, after which they are ground to size on centers.—H. B. KELLAM.

Spotting, Sawing, Stamping

(*Continued from page 86*)

is a plain cast lug, it is advisable to set a short, hardened pin into it opposite the screw in the movable stop, and to round the ends of both on a radius so as to give a point contact on the gaging blocks used for the longitudinal feeds.

Added advantages of spotting with this device are that "stepped" or recessed work, as well as parts having inclined surfaces, can be handled, and that the spots are always true, so that the lathe test indicator can be relied upon as showing where the location is centered on the faceplate.—HENRY SIMON.

WHEN a number of pieces of small bar stock have to be cut off the same length, much time will be saved if several bars are clamped together in the power hack saw as shown in Fig. 3, page 86. A clamp can be forged to hold the bars.

At the beginning of the operation, the bars are set with their ends flush, and the clamp tightened. When the first series of pieces are cut off, the group of bars is moved forward as if it were a single piece.—H. L. WHEELER.

ON THOSE occasions when a small quantity of stamped articles are required by a shop not provided with a stamping press, it is possible to turn them out with simple tools, and furnish the power with a sledge hammer.

Figure 4 makes clear the method. A die block is made with a clearance hole through which the stamped pieces pass. To the top of this block is screwed a tool-steel die plate with a hole the shape of the article to be punched. The punch is attached to a plunger intended to be struck with a hammer.

Two dowel pins are provided to insure the alignment of the punch with the die. These should be a close fit. The die plate should be hardened and tempered. The punch may or may not be hardened.

Probably the best way to construct the assembly is to complete the die portion and fit the plunger and its dowels. Then, with the punch within the die, the holes for attaching the punch to the plunger can be drilled through the punch and into the plunger. This will make certain that the punch will line up with the die.

For soft metals, both the punch and the die can be made of machine steel and casehardened; for steel, however, it is best to make at least the die of tool steel.—J. H. DOWNIE.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Mississippi Steamboatin'

(Continued from page 55)

See the inverted view of the stern on page 124.

A cut is made on the outside to the line *B* (shown on the side view of the stern, page 124). From aft to this line a fore-and-aft cut is made, leaving an upright sternpost on each side. Forward of this cut, the hull is rounded until the side is again vertical at 2 in. from the stern.

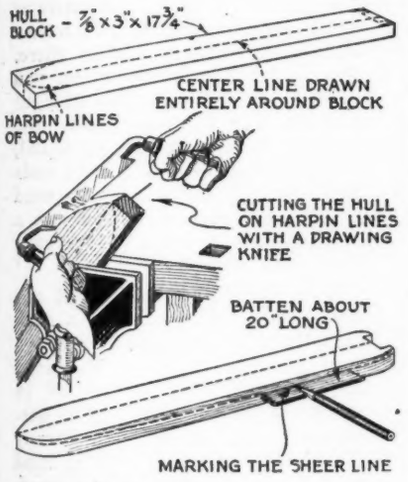
At ⅛ in. from the outside edge of the sternposts, new cuts are made into the end of the hull almost as far as the lines *B*. In between them the wood is cut away to form a double curved arch, which is deepest at the center to conform to the line of the bottom of the hull. This is almost impossible to describe, but the lower photograph on page 54, the drawings below and on page 124, and the full size views in the blueprints will give you an accurate idea of the shapes.

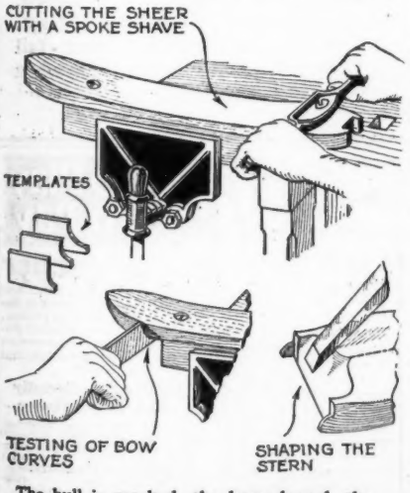
These cuts leave the two ⅛ in. thick sternposts standing. The deck line is straight across to the outside edges of the sternposts. The two side horns project farther aft.

The stem (at the bow) may be left as part of the solid hull, but it is easier to cut it away and put on another piece afterwards. A very thin keel may be added, but it is so slight that I omitted it on my model so that the hull would lie flat. A thin strip of wood or cardboard glued on will serve.

The hull can be given three or four coats of flat white paint and two of black, rubbed smooth between coats. After the ground coat of flat white, I used brushing lacquers entirely on the model. They dry quickly, and in this model a high finish such as they give is desirable.

Next comes the main (Continued on page 124)


HULL BLOCK - ⅞" × 3" × 17¾"
CENTER LINE DRAWN ENTIRELY AROUND BLOCK
HARPIN LINES OF BOW
CUTTING THE HULL ON HARPIN LINES WITH A DRAWING KNIFE
BATTEN ABOUT 20" LONG
MARKING THE SHEER LINE



The hull is marked, the bow shaped, the sheer cut, and the carving completed.

Your Present Radio

..can be made an Electric A.C. Set *without changes in wiring or even the cost of new tubes*

Kuprox A.C. Power Pack. Makes any battery set an electric A.C. receiver. $32.50 up.

THERE'S no necessity for discarding a good battery operated receiver to get the convenience of A.C. operation. The Kuprox A.C. Power Pack converts any good set into an electric A.C. set, without changes of any kind in wiring, without the use of harnesses or adapters.

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Kuprox Multi-rate Rectifier, for trickle charging, dynamic speaker operation, etc. $11.50

Several models are offered. One that supplies all radio power for any size set. Or separate filament and plate models for those who desire this form. And an efficient "A" model that supplies filament current and will operate in conjunction with any good "B" eliminator. Priced from $32.50 up. See the various models at your radio dealer's. Or, if you first desire more information, we'll be glad to send it if you will write.

Kuprox Replacement Unit eliminates acids, liquids, bulbs from trickle chargers $5.00

TELEVISION! Kuprox A.C. Power Packs are necessary for operating television receptors, which require perfectly smooth D.C. current for motor supply, filament, plate and glow circuits.

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Formerly The Kodel Radio Corp.
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KUPROX A.C. POWER PACK

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Wood and Fittings as Aids to Model Ship Builders

TRIFLES make perfection but perfection is no trifle as makers of ship models know from first hand experience. Many a model that is beautiful in hull and spars is spoiled by the fittings being out of proportion or poorly made.

By using Boucher fittings you can get a perfection in your details that is almost impossible if you make these tiny parts by hand.

In this advertisement we have reproduced just a few of the scores of fittings that are available at Boucher, Inc. Our booklet, SCALE MODELS, shows exactly how these fittings look, sizes, materials of which they are made, and prices.

CAPSTANS
Varnished Boxwood
3/8" Scale .$ .50 each
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Wood

It is often very difficult to secure, locally, wood called for on particular models. Boucher can supply your wood requirements in almost all cases. Below is listed wood required for a particular model with prices.

White Pine
20X5 inches—1/8 inch thick.....$ .70
40X5 inches—1/8 inch thick..... 1.40

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20X5 inches—1/16 inch thick.....$1.45
40X5 inches—1/16 inch thick..... 2.90

Other Woods:
Write us if you desire some particular kind and size of wood and we will be glad to quote you a price, uncut or cut to shape.

Send for Booklet "Scale Models"

This booklet—SCALE MODELS—has 92 pages of useful information for model makers. Contains history of steam engines, nautical terms, knots, hitches and splices commonly used on boats. Recommendations for finishing and painting model ships and hundreds of other ideas you will find useful.

Whatever type of ship—sail or steam—ancient or modern—you are building, or planning to build, you will find the booklet, SCALE MODELS, of tremendous help. Send 25c today for your beautifully illustrated copy. It will be sent you by return mail, postage prepaid.

Gentlemen:—Enclosed is 25c for which please send me immediately your 92-page illustrated booklet, SCALE MODELS.

Name.....

Address.....

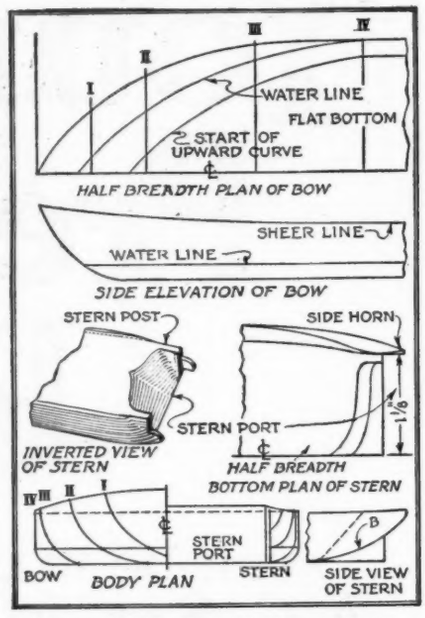
Headquarters for Model Makers for 23 Years

Boucher Inc

415 Madison Ave. Dept. SN N.Y.

Mississippi Steamboatin'

(*Continued from page 123*)



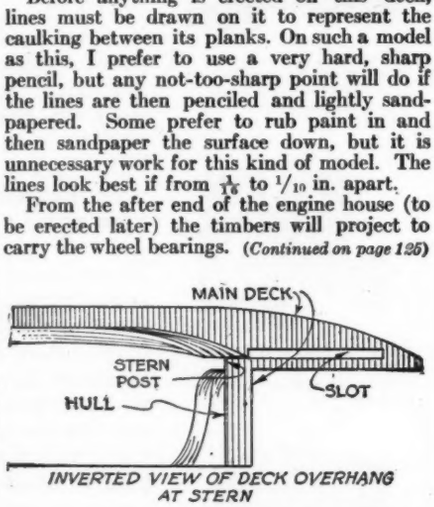
Bottom and side views of the bow and stern, the body plan, and a sketch of the stern.

deck, for which I used holly. This and the other decks should be a scant 1/16 in. thick.

The main deck extends beyond the hull all around except at the stem, and the after end has a slot on each side to allow the pitman, or connecting rod, to work. The strips of deck inside of these will project accurately from the extended parts of the hull. The deck should be glued and lightly nailed to the hull.

Before anything is erected on this deck, lines must be drawn on it to represent the caulking between its planks. On such a model as this, I prefer to use a very hard, sharp pencil, but any not-too-sharp point will do if the lines are then penciled and lightly sandpapered. Some prefer to rub paint in and then sandpaper the surface down, but it is unnecessary work for this kind of model. The lines look best if from 1/16 to 1/10 in. apart.

From the after end of the engine house (to be erected later) the timbers will project to carry the wheel bearings. (*Continued on page 135*)



How the deck is prepared and slotted at the stern to allow the connecting rods to work.

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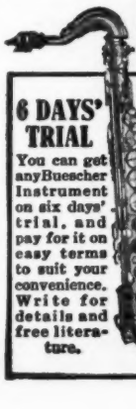
THE PORTER CHEMICAL COMPANY
115 Summit Ave., Hagerstown, Md.

If I had a workshop

OUT in the garage, in the attic or downstairs somewhere, I'd have a couple flashlights handy there. Ready for the times when you need an extra-bright eye of light to help out. I'd have them, too, as a fire-prevention measure. Oil, waste and those odds and ends that always collect don't need much encouragement to cause a serious fire. Give *me* Eveready Flashlights and safety.

The flashlight habit will see you safely through many a dark situation. You can't begin too early, either. Get an Eveready today and promise yourself to use none but the very best of batteries in it. They're Eveready Batteries, of course. The kind that lasts so long. *Extra*-good. Packed with a BIG load of light. Always dependable, never-fail Evereadys. Remember them when you reload a flashlight.



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Saxophone gives you these extra features—Snap-on Pads, greatest improvement, easy to replace, no cementing—Patented Automatic Octave Key—perfect Scale Accuracy—convenient key arrangement.

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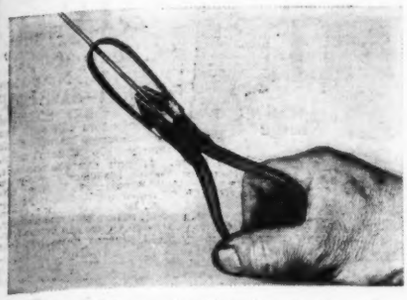
Buescher Band Instrument Co.
2221 Buescher Block, Elkhart, Ind.

Old Pliers Adapted for Holding Thin Pins



A piece of flat stock soldered to the jaws of the pliers aids in holding small round stock.

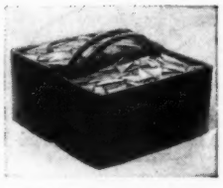
FROM a pair of old pliers with broken cutting edges and worn-out jaws, a machinist made an ideal tool for holding any length of round stock of small size for soldering, hardening, and tempering.

After thoroughly cleaning the surface of the pliers, he bent over a length of flat stock and "sweated" it to the jaws as shown above. Then he drilled a hole through the flat stock to clear the work.

Wire or pins held with this tool do not slide around sideways even though the pliers are gripped only lightly.—A. K.

Unusual Carrying Box Has Handle at One Side

ORDINARY tin boxes, in which various goods are packed, serve well as "tote" or carrying boxes in the shop after they have been emptied of their original contents. Special boxes of this kind are illustrated. Each of these has only one handle, made by passing a length of strap through punched holes in the side and tying the ends.



Tin boxes with leather handles placed to allow two of them to be carried in one hand.

These boxes are used for carrying scrap parts from machines in places where it is impossible to push a truck. Because there is only a single handle on one side, one man can carry four of the boxes at once, two in each hand. The weight of the contents holds each pair of boxes close together when the handles are gripped and lifted.

Mississippi Steamboatin'

(*Continued from page 124*)

These pieces are 3½ in. long and are shaped as shown on page 124. They follow the deck sheer, slanting upward a scant ⅛ in. The fore parts are firmly nailed and glued to the deck; then the after parts of the deck are bent up to meet them and glued and bolted together.

A $\frac{1}{16}$-in. molding is run right around this deck. The fore part had better be fret-sawed to shape, but the rest can be bent in position and glued and fixed with ½-in. pin points.

Nearly everything that has to be on this deck will have to be put in position before it is closed in with the deck above. Particulars of these fittings will be given next month.

Some who plan to build the boat on a larger scale may want to make a working model of her. To do this the main deck should be in two pieces. One, an outer rim with all the superstructure erected on it, should be made to lift off, while the center portion remains fast to the hull and carries the engine and boilers, or whatever mechanism is used.

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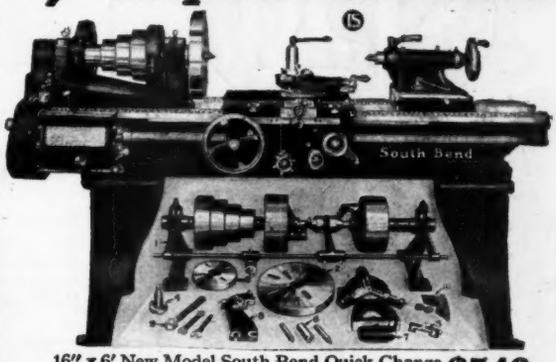
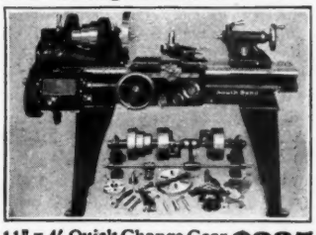
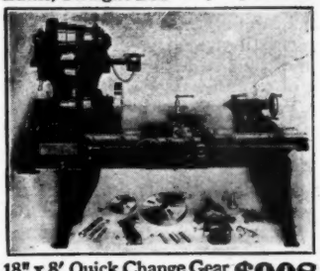


16" x 6' New Model South Bend Quick Change Gear, Back Geared Screw Cutting Lathe - - **$540**

9" x 2½' Junior Back Geared Screw Cutting Bench Lathe **$150**



11" x 4' Quick Change Gear Lathe, Straight Bed - - **$335**



18" x 8' Quick Change Gear Motor Driven Lathe - - **$908**

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No. 2 Lathe, Wheels to 36" dia. **650**
No. 3 Lathe, Wheels to 42" dia. **1400**

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Size of Lathe	Shipping Wgt.	Standard Change Gear	Quick Change Gear
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11" x 4'	725 lbs.	300.00	335.00
13" x 5'	1110 lbs.	352.00	402.00
15" x 6'	1550 lbs.	430.00	490.00
16" x 8'	2035 lbs.	510.00	570.00

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How to Open Stuck Window Sash

Paste this Home Workshop Reference Sheet, including the head above, in your scrapbook in the section marked *windows*. (Nov., 1928, POPULAR SCIENCE MONTHLY.)

WHEN the lower sash of a double-hung wooden window—that is, an ordinary sliding window—sticks, how can it be opened and remedied?

1. Find out why it sticks, if possible. Is it held by a film of paint or varnish, does it appear to have been fitted too closely, has the wood swollen badly, or may the fault be laid to all three?

2. If paint is the cause, tap the sash, the stop strips, and the stool cap (often called the inside sill) lightly to break the film. Use a piece of wood to prevent hammer marks. Push or strike lightly with the hand under the top, or meeting, rail. This should start the sash. Perhaps rapping sharply downward on the end of each stile or sidepiece may break the paint film of that joint.

3. In case of the second or third cause, or both of them, pry the sash up by using a wide, thin chisel between the sash and the stool. Do the prying from the outside if the window can be reached conveniently, so that the bruises will not be seen from the inside.

4. If the sash does not start, drive the chisel very carefully between the stool cap and the lower rail of the sash in the middle so as to spring the lower rail and break the film of paint. A light tap on the sash may break the film of paint, but it may also break the glass or the putty.

5. If the sash still sticks, drive the chisel into each jamb or pulley stile just above the sash and closely against the back edge of the stop strip. Pry gently on the chisel against the strip, starting the screws or nails in the strip, if necessary.

6. If the sash will not start, try the chisel where it was driven as in No. 4 above, but at the lower end of each stile instead of the middle of the rail. Pry gently. Avoid using the chisel thus if possible, as it will bruise the wood. Such a bruise sometimes may be reduced by applying water on a cloth pad.

7. If the sash is swollen, remove the stop strips at each side (see the following topic on how to remove sash) and plane a few shavings the entire length of the back edge of each. Take more off above the lower sash to allow the sash to slide upward easily once it has started. Also ease the outer edge of the stool with a bullnose or rabbet plane and chisel if the sash sticks at this point, as it often does. Touch the edge with paint afterwards, for it is exposed to the weather when the lower sash is open.

8. If the weight cords are pulled down as far as possible and allowed to snap back simultaneously, the jar may start the sash.

How is the upper sash loosened?

1. Try method No. 4 above. Gentle tapping upon the meeting rail may start the upper sash, but as the rail *(Continued on page 127)*

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Stuck Window Sash

(*Continued from page 126*)

and stile joints are easily broken, it should be avoided if possible.

2. Pry down powerfully on the outside of the window at the top, over the ends of the stiles (sidepieces). Use the chisel more gently to pry between the sash and the blind stops (the outside stops) on both sides.

3. In stubborn cases, remove the lower sash (see the following topic) and use a broad chisel to spring the parting strip as far as possible from the dado or groove in which it is fitted. This strip separates the upper and lower sash while they are sliding and makes the vertical joint as nearly weatherproof as possible.

How should one prevent a recurrence of the sticking?

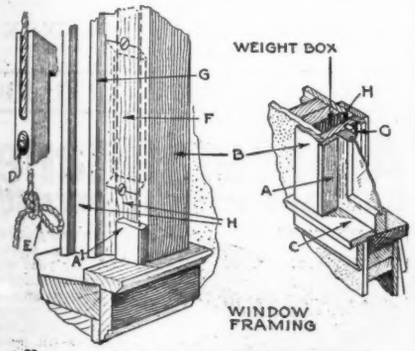
Plane the edges of the sash, either upper or lower, if the evidences of friction show that the sash is too wide. If they do not need planing, apply talcum powder or rub all surfaces which may stick with a paraffin candle or hard soap.

It is always best to do as little as possible to start a sticking sash, until you find out if a spell of dry weather will be sufficient to cure the trouble.—C. A. K.

How to Remove Upper and Lower Sash

HOW would you remove the lower sash of a double-hung window for replacing broken sash cord or glass?

1. Remove the left stop strip *A* by preference, as this will allow right-hand work. If the cord on the right side is to be repaired, however, the strip on the right side (A^1) should be removed. Back out the screws and tap the strip lightly on the face or on the sash edge, not on the front edge, if the strip does not spring off when the screws are removed. Do the tapping on a small piece of wood to prevent hammer marks on the varnish or paint finish. Drawing a knife blade along the joint between the strip and the casing *B* will cut the surface film of the finish, if the tapping is not sufficient. If the strip is nailed on instead of fastened with screws, begin at the middle with a wide



How a typical wooden window frame is made for a double-hung or sliding sash.

chisel and pry it carefully away from the casing. Because of the hardened putty or filler in the nail holes, it is best to pry the strip right off and either pull the nails out through the back or cut them off. Any attempt to draw the nails through the face is almost certain to mar the finish. Spring the strip out from the center, which will shorten it, and release the ends from the stool and the header to prevent scratching the finish of the stool cap *C* and the head stop strip. (*Continued on page 128*)

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No. 4 ELECTRIC TOOL CHEST

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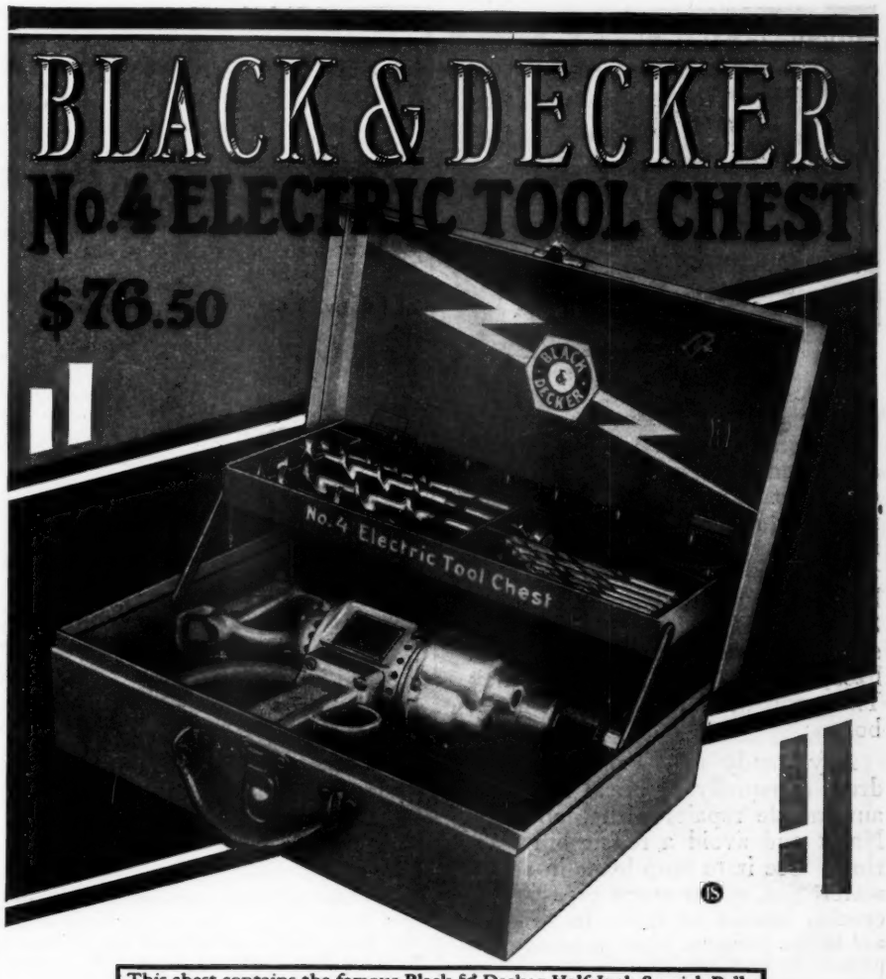

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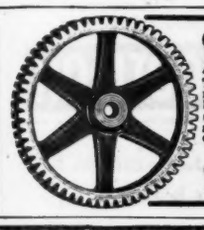

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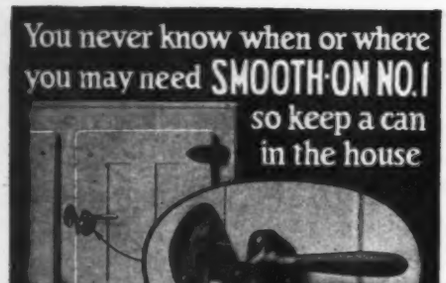

A 50-lb. block of ice dropped on this icebox handle, bent the cast brass lever, stripped the screws out and splintered the wood. As larger screws could not be used and the lock could not be shifted, a new door seemed necessary. Instead the owner fitted the splinters back, filled the screw holes with about 5 cents worth of Smooth-On No. 1 and put back the screws. When the Smooth-On metallized, the lock became strong as new. The repair will last as long as the icebox.

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11-28

How to Remove Sash

(Continued from page 127)

2. Lift the sash above the stool cap and draw the edge of the sash into the room enough to allow the sash cord to be removed. Usually the cord will be fastened to the sash as at *D*. Pull the cord down to give a little slack, remove the knot from the hole, and untie the knot or cut it off if the cord is long enough and is to be used again. Tie a slip knot as at *E*, and with a finger through the loop, allow the weight to pull the knot up until it stops at the pulley.

3. Remove the cord from the other side by the same method. The stop strip has to be removed from that side only if the weight there must be rehung. Then it has to be removed to allow access to the pocket in the pulley stile which usually is fitted as at *F*, so that it can be taken out to reach the weight.

How do you remove the upper sash?

1. Remove the lower sash as just described.
2. Lower the sash until it rests on the sill or as far as the cords will permit.
3. Remove the parting strip *G* from the groove in the pulley stile or jamb *H*. If the strip is held by paint or varnish, loosen it by the method described at the beginning of the answer to the previous question. Usually the left strip will be more conveniently handled. If necessary to pry it out, use a thin-edged chisel and pry carefully where the chisel marks will not be seen on the inside. Work from the part of the strip which you find you can loosen most easily.
4. Remove the cords as described for a lower sash.—C. A. K.

How to replace broken sash cord and how to put in a new pane of glass are the next topics scheduled for publication in the form of Home Workshop Reference Sheets.

Antiquing Ship Models

ONE of the hardest tasks for the beginner in ship model making is to give his handiwork the weatherbeaten appearance so often desired on models of galleons and other ships of the fifteenth, sixteenth, and seventeenth centuries. The method used by the writer in painting more than a dozen ships sold by him to friends and neighbors is as follows:

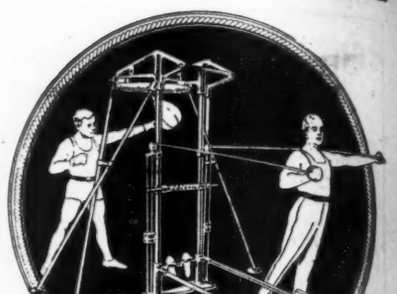
First paint the model the desired colors, using bright hues. Artists' oil colors sold in tubes can be used, although I have found small ten-cent cans of household paint serve very well.

Obtain a can of flat varnish, sometimes called "velvet finish" varnish, and a small amount of dry lampblack. Mix a level teaspoonful of lampblack in half a pint of the flat varnish. Add the powder directly to the varnish without first dissolving it in turpentine, as ordinarily would be done. Apply this mixture, thoroughly stirred, to the model and brush it well into all corners and angles. The small lumps of lampblack break under the pressure of the brush, giving a streaky, weatherbeaten, antique appearance.

With this method, it is not necessary to rub down the gloss, as the varnish itself is dull.

Models of clipper ships, frigates, whalers, barks, and other relatively modern ships should not, of course, be antiqued, but the gloss should be rubbed off all painted and varnished surfaces.

As rubbing small parts is a tedious task, it is well to assemble a ship model (except the masts, sails, and rigging) and add all the deck fittings after they have been painted. Then spray the whole with flat varnish or lacquer. There are now many inexpensive spraying outfits—hand, foot, and electric—available for work such as this.—M. Cyle Smock, Jr.



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Trick-Performing Puppy

(*Continued from page 80*)

Select a well-shaped, well-preserved pine cone of medium size and secure the neck and feet in place with sealing wax such as is used in fruit canning. Only the wooden parts need be painted.

TO MAKE the funny man shown in Fig. 4, obtain a small round cardboard container for the body. Prepare the legs and feet and place the pivot for the legs about two thirds of the way up the side of the box.

An eightpenny nail will form the pivot. Two sections of lead pencil are used as spacers on each side of the legs. The arms are placed on the same pivot. The bottoms of the feet are slightly rounded to allow the toy to rock back and forth. Bright colors should be used for painting the finished toy.

When started down an incline of about 15 degrees, the little fellow, if properly balanced, should keep toddling until he reaches the bottom. Exact balance is the secret; this may be obtained by adjusting the arms to different positions.—F. C. H.

NEARLY every boy knows of the flying propeller. A novel way of spinning one of these is indicated in Fig. 5. If the roller is held at an angle, very long flights can be made; if held straight up, the propeller will go to a great height. The propeller must, however, be made small so that it will rotate rapidly.—J. D. GEORGE.

AN ALARM clock spring furnishes the power, and common straight pins are used in the trigger mechanism of the simple but realistic model crossbow illustrated in Fig. 6. It will shoot "match" arrows with great force and surprising accuracy.

The stock is made from a piece of soft wood ⅜ in. thick and 8⅝ in. long. The top edge has a groove down the center for the arrow.

The pin upon which the looped trigger revolves is 3⅛ in. from the butt of the gun. To make the trigger, bend a small loop in about the center of the pin and drop some solder where the two legs come together. Fit this looped pin in a slot in the underside of the gun. One end (the end with the head) is the real trigger, while the other end moves the releasing pin up and down in a hole just its size. The releasing pin is just long enough so it will catch a tiny loop of wire on the bowstring.

The 12 in. long bow is a built-up spring with from four to seven leaves, depending on the kind of springs used. The leaves are bound with wire.—CHARLES H. TAYLOR.

Repairing Ukuleles

WHEN a ukulele, banjo, mandolin, or similar instrument will not produce correct tones, I have found the cause to be almost invariably one of the following: Loose pegs, defective strings, frets not accurately placed, or nut too high from the fingerboard.

Common pegs are likely to slip after having been used a number of times; they can be enlarged by boiling them in water. If the pegs are of the nonslip style and will not work, the threads are stripped.

There is only one way to remedy defective strings and that is to buy new ones. If any frets are a thousandth of an inch out of place, discords often will be produced. This defect cannot be remedied.

If the nut is too high from the fingerboard, the strings, when pressed, will give sharp notes. It will be found that if the nut is filed down and new notches put in so that the strings are only a small fraction of an inch above the frets—but be sure they do not touch—an improvement in the tone production will be noted.—LEROY OLSON.

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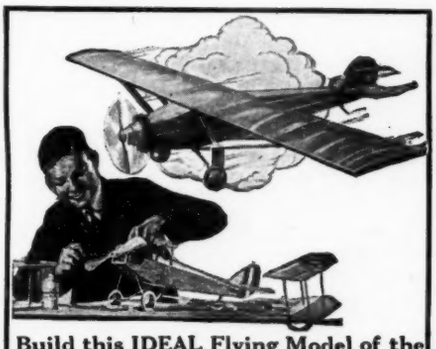

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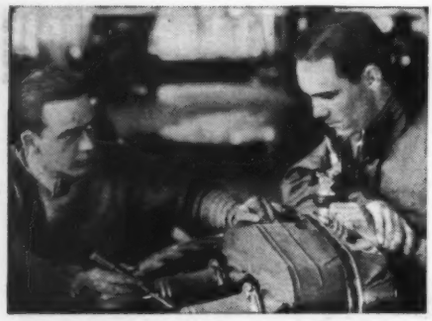

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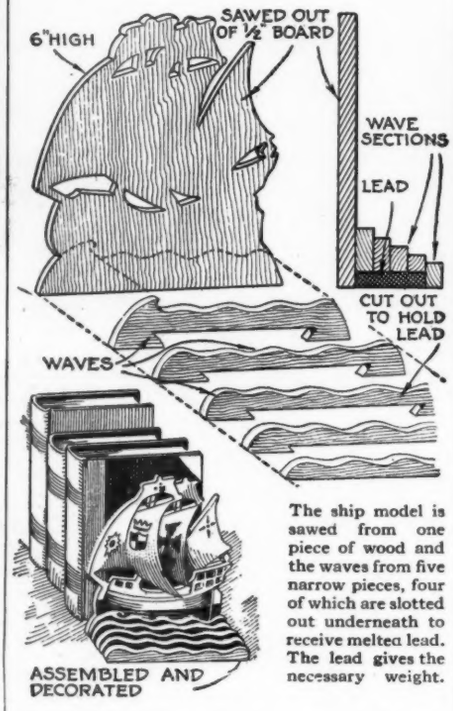
Ship Model Book Ends Sawed from Thin Wood



The ship model is sawed from one piece of wood and the waves from five narrow pieces, four of which are slotted out underneath to receive melted lead. The lead gives the necessary weight.

IN MAKING the book ends illustrated, I used ½ in. thick soft white pine—hardwood would have served as well or better. A piece of old lead drain pipe was melted to give the necessary weight.

The ship itself is cut from a piece 5½ by 6 in. The waves, which form the base of each block, are cut from five pieces, the largest ½ by 1¼ by 5½ in. and the smallest ½ by ⅜ by 5½ in.

The parts are nailed together, turned upside down, and held in the vise while melted lead is poured into the dovetail recess in the bottom. A piece of heavy felt is glued across the bottom to prevent the book ends from scratching.

The sails are painted white, the designs on them red and black or any desired color, the windows white with black bars, the hull brown, and the water dark green with white touches to represent spray. Although it is not essential to do so, I first burned all the lines into the wood with a hot nail set in a handle and then painted the lines black to emphasize the design.—JAMES CAMPBELL.

Planing Long Edges Straight

AMATEUR woodworkers and even carpenters find it difficult to plane the edges of long boards reasonably straight, as when a number of pieces have to be joined to make wide shelving. I find it a great help in all such work to stretch a line or wire taut on top of the bench and drive a row of finishing nails partly into the wood at one side of the line, close to but not touching it. It is essential, of course, that the nails stand exactly plumb. When I have planed each piece to be straightened until it will touch all the nails, I know that the edge must be fairly true.—W. W. S.

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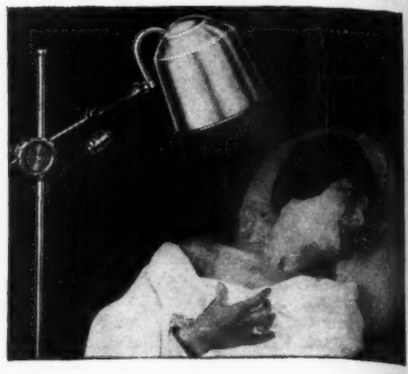

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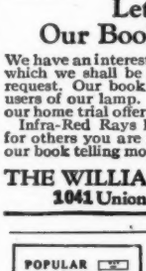

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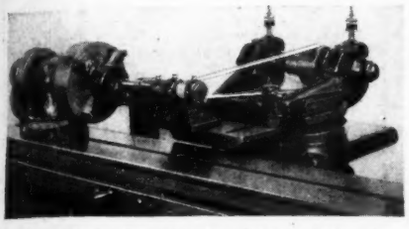
Internal Grinding

(Continued from page 84)

Centers should be lined up occasionally for a test. If they are not in line, the operator will find it difficult to get a perfect bearing on the plug gage.

The combination faceplate in Fig. 1 is often useful. The false plate with its six set screws permits the truing up of long cylindrical pieces from both ends. The front end may be diverted in any direction simply by adjusting the proper screws which bear against the regular plate. This arrangement will take care of any work which, on account of its length, has a recessed hole and substantial bearings on each end. Fig. 2 shows how the work is held on the plate. A strap is inserted in the recess against the bearing, and this in turn is held by a rod passing through the head spindle. The piece is trued accurately with the indicator at both ends. The first bearing is ground and the end is squared up; the piece is then reversed and the operation repeated. This method assures a perfect line-up of both bearings.

Plug gages, if made as in Fig. 3, will prove most economical for the tool room. One handle



One of the important points in internal grinding is to choose a wheel not more than seven eighths or less than three quarters the diameter of the hole that is to be ground.

serves for all plugs up to 1.000 in. Gages from 1.000 to 1.500 in. are made as in Fig. 4; from 1.500 in. up, the disk style, as in Fig. 5, is the cheapest and most convenient.

A difficult job in internal grinding is the turning out correctly of a sleeve or bushing with a very thin wall. The set-up shown in Figs. 6 and 7 is for an interchangeable sleeve used in a testing fixture, the wall being only 1/32 in. thick. The hole is bored .012 in. undersize and .015 in. is allowed on the diameter for grinding, as the distortion due to hardening is apt to vary.

After the sleeve has been polished inside and out to remove the scale, it is soldered to a V-angle as shown. The assembly then is bolted to the faceplate, and the truing is done with reference to the hole. After the hole has been ground carefully to .0005 in. under finished size, the end is squared up with the side of the wheel. The grinding should be done very slowly so as to heat the work as little as possible. The other end of the sleeve is surfaced on the surface grinder, and the whole is then lapped to size. To finish the diameter, the sleeve is fitted to a mandrel that has been ground straight and is soldered on the ends just enough to hold. The results are satisfactory, as the piece being ground is not subjected to any expansion or contraction.

Another tool that requires skillful grinding is the ring gage. These should be made with shoulders as in Fig. 8 in order to prevent any error at the edges of the hole—a most important consideration. The shoulders are removed after the hole has been lapped.

After hardening, ring gages should be given the cold and hot water treatment; that is, they should be immersed in boiling water, then in ice water, about thirty consecutive times. Then they should be allowed to remain at a temperature of 60° to 65° for a week before grinding.

Three plug gages should be used for grinding the hole: a double-end (Continued on page 132)

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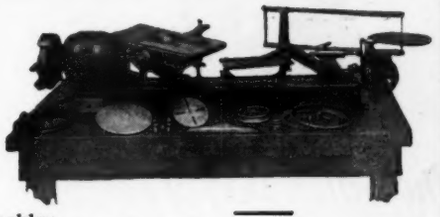

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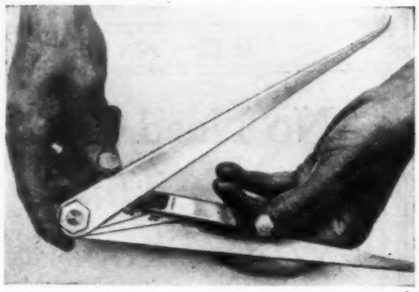

Calipers marked to serve as a rough and ready protractor for identifying angles.

ANGLES of 30, 45, and 60 degrees are often encountered on valve seats, cutters, and reamers, but the faces are usually so small that it is difficult to determine instantly what the angle is. If marked as shown in the illustration above, the calipers may be used as a protractor for measuring such angles when extreme accuracy is not a matter of concern. This saves many a walk to the tool box to get the combination head and scale, or the trouble of adjusting them if they happen to be set for another purpose.—F. B.

Internal Grinding

(*Continued from page 131*)

plug, one end .005 in. and the other end .002 in. under size; another plug .0005 in. under size, and finally the standard gage, .0005 in. being allowed for lapping. It is important that the last .001 in. be ground off very slowly so as to favor the lapping operation.

The lap should run true in the speed lathe. The lapping is done by rocking the gage and making the circle evenly in the same location on the lap. There should be no sliding action. After cleaning the gage with gasoline and testing it, the operation is repeated if necessary, a new location on the lap being used.

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The "SELF-ADJUSTING" Rheostat

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Better Ways to Do Woodworking

(*Continued from page 56*)

Boring a dowel hole with a block of wood on the bit to serve as an improvised depth gage.

are complicated it is best to lay out a rod; then measurements are made once for all, and the layout is easily transferred from piece to piece.

In making measurements on the rod, stand the square on edge, so that the division lines will meet the surface of the wood. Locate the points with a knife. Score these lines square across the width and label them with a pencil.

An intricate piece, upon which you expect to work for weeks, requires more than a mere stick. For it you should prepare what a cabinetmaker would call a "rod" but what is really a thin board, often as wide as 11 in., upon which a full size sectional plan and an elevation are drawn accurately with a pencil. The edges of the board must be straight and parallel so that a square can be used in drawing the various members.

In sawing, never forget that the blade takes up space. The kirf is usually a little less than $\frac{1}{16}$ in. wide, but is sometimes wider. If the mechanic cuts on the line, he is not sure of the placing, and if the measurement is accurate the pieces will be at least $\frac{1}{32}$ in. undersize.

For all joints, the proper method is to allow the teeth of one (*Continued on page 134*)

Whenever wood must be hammered, use a soft block of waste wood as a protective cushion.

Used by Leaders because They are the Leaders in their Field!—with many types of resistances from which to choose, it is highly significant that the most important radio and electrical laboratories and manufacturers in this country have standardized on DURHAM Resistors, Powerohms and Grid Suppressors. The reasons are plain. *First*—there is a DURHAM Resistance unit for every practical need up to 100 megohms. *Second*—the DURHAM Metallized principle has proved its utter superiority for years. *Third*—DURHAM accuracy and uniformity can be relied upon regardless of the type of unit or the purpose for which it is used. Each succeeding year sees more manufacturers, laboratories, professional radio men and dealers and jobbers endorsing DURHAMS. Descriptive literature on the DURHAM line gladly sent upon request.

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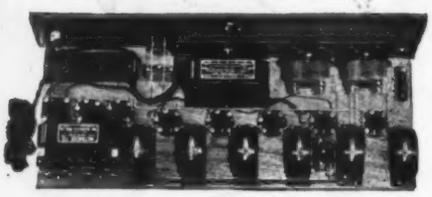

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Blue Print Free, together with full constructional details. Write for it today.

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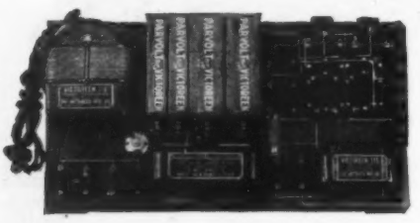
the Victoreen "B" Power Supply



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The Geo. W. Walker Company

Merchandisers of Victoreen Radio Parts

2825 Chester Ave., Cleveland, Ohio.

Victoreen

Quality Radio Parts

Better Ways to Do Woodwork

(*Continued from page 133*)

side of the saw to cut the center of the scratch, removing half the line and leaving half on the piece. This keeps the blade in the waste wood, retains a positive working line at all points, and insures a straight cut. If the edge is to be dressed after being sawed, the cut may be made a trifle to the side—enough to allow two or three shavings to be removed before the center of the line is reached.

In starting a side cut for a dado or for the shoulder of a tenon, it is often helpful to cut the starting corner with a knife, notching it in the waste wood. This gives a starting point for the saw and prevents it from dancing around on the surface before biting in.

IF TWO boards are doweled together, it is most important that the face edges come smoothly flush. This requires great accuracy in the location of the dowel holes. Clamp the two pieces together, joining edges up, with both face sides out, and square across the edges to locate the holes with reference to the length. With a gage set to center on the thickness of the wood, scratch across these lines from the face side of each board. As the head of the gage bears against the face sides, any variation from the center on one piece is duplicated on the other. If the boring is true, the faces must be in line when glued up.

Since the grain of the wood will "lead" the bit point, it is well to center-punch the intersection of the marks with a nail or a nail set so that the bit will start accurately. A bit gage or a wooden block bored to slip over the bit, is a help in boring the holes to a uniform depth and eliminates the danger that some of the dowels will strike and prevent the joint from closing.

Another precaution: a small amount of space at the bottom of the hole must be allowed for imprisoned excess glue. Glue is no more compressible than water and is too thick to ooze past the dowel pin; if, then, the clamps are screwed tightly enough, the glue will expand the hole by splitting the wood.

The assembling of cabinet parts often requires them to be tapped with a hammer to force the joints together. Every hammer blow, however light, means a bruise on the wood, unless a block of soft wood is used as a buffer between the hammer and the work. Blocks should also be used under clamp jaws.

SCRATCHES and mars on the piece seem inevitable, but much ordinary scuffing is avoidable. Only necessary tools should be rested on finished surfaces of the wood. Touch the square gently to the surface; and do not lay a saw on the board at all, for when the tool is picked up again the teeth will surely scratch. Before laying a smoothed side against the bench top or sawhorse, be sure that all shavings, sawdust, and splinters have been swept away.

Most cabinets should be sponged with warm water before the final sanding; this process not only swells flush any small bruises, but raises the grain. When the grain has been sandpapered down again, it will not be affected to any great extent by the application of the stain, which otherwise might raise it badly. Deep bruises often can be steamed out with wet blotting paper and a hot flatiron.

NO HOME worker should risk the discouragement and possible loss of interest that comes from the improper grinding and sharpening of his cutting tools. To work happily and successfully with dull, poor tools is impossible. In some cases the dullness may be due not so much to lack of the necessary skill to keep the tools in order as to the fact that the sharpening processes are not regarded as interesting in themselves. Yet they will become interesting if you study and practice them.

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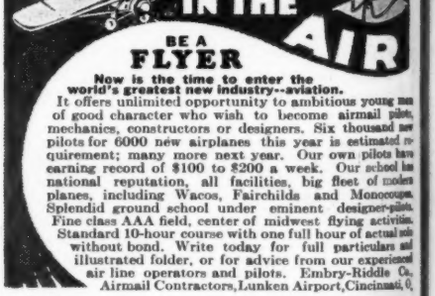

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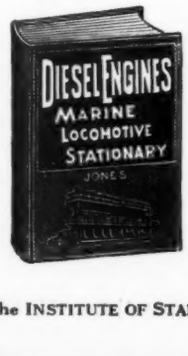
Marine and Stationary

By Ensign DAVID L. JONES, U. S. Navy



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Price $5.00

Popular Science Monthly
250 Fourth Ave. New York, N. Y.

Monoplane Flies Indoors

(Continued from page 82)

the fuselage 3 in. from the rear end of the fuselage. Touch the points with cement.

The "cans" or rubber guides are of No. 5 piano wire. Make a ring about ⅜ in. in diameter. Bend the ends parallel as shown and slip them over the fuselage. The front can goes 3¼ in. from the nose, the rear can, 8¾ in. from the nose. The cans are secured in place with a drop of cement on each side.

The wing has two spars of white pine, 1/16 by 3/32 by 18 in. These are sanded smooth. Soak the spars at the center and bend over a candle flame until the ends of each are 1 in. higher than the center. This forms the dihedral and makes the model stable in flight.

The ribs are bamboo, a scant 1/32 in. square by 3¼ in. long. Curve them over a candle. The curve is 3/16 in. high, and the highest part occurs one third the rib length from the leading edge. The ribs are bound to the spars with two wraps of silk thread each way, and are cemented. One rib is placed in the center and the others are spaced 4 in. apart, leaving a spar overhang of 1 in. to which the tip outlines are bound and cemented.

THE tip outlines are semicircular and extend 1½ in. beyond the spars. Form them over a candle flame from 1/32 in. square bamboo.

The wing is held securely to the underside of the fuselage by two clips made of No. 8 piano wire. The front clip holds the wing spar 3/16 in. from the fuselage to give the necessary rib clearance. The rear clip holds the wing spar ½ in. below the fuselage, thus giving the wing the necessary angle of incidence. Bend a loop in the wire and run the parallel ends up 3/16 in., then downward and outward so that they will meet the spars ½ in. each side of the center rib. Here they are bent parallel to the spars in a tight loop ⅛ in. long and are bound to the spars with four or five wraps of thread and fixed with cement. Make the clips true so that the wing will be aligned properly, and do not have them grip the fuselage too tightly, as that might injure the stick.

Cover the tail, wing, and rudder with Japanese tissue, with rice paper, or even with soft tissue, although the last is not so strong. Stick the paper with banana oil to the bottom side of the tail. Apply the adhesive along the thread and the tail spar. Work rapidly, as the oil dries fast. Trim off the margin, leaving an edge of 1/16 in.

Cover the rudder in the same manner on one side only. Trim off the margin with a razor blade and give the tail and rudder a sparing coat of thin banana oil (it can be thinned with acetone).

COVER the wing on the top side, working out a section at a time. Pull the creases out lengthwise so the curve will be preserved. Trim away the margin and apply a coat of banana oil. As the oil dries, warp the wing in the hands until the left side has about 1/16 in. greater incidence than the right. This is to counteract the torque of the large propeller.

The propeller is of the true pitch type. Select a block of very soft, light white pine, ½ by 1⅜ by 10 in. In the exact center of one 1⅜-in. face locate a dot, and on the other 1⅜-in. face place a similar dot. On each face draw two lines diagonally from corner to corner, crossing at the center dot. Draw parallel lines 1/16 in. on each side of the center dot. This is to give body to the hub.

Cut along the outline to form the blank. Drill the center hole and carve out the propeller. It is cut so thin you can see light through it two thirds of the way to the hub. The cross section should resemble a wing curve. The convex side is the front side of the propeller.

After the propeller is carved, make a paper pattern of a graceful (Continued on page 136)

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Cunningham RADIO TUBES

Monoplane Flies Indoors

(*Continued from page 135*)

tip and then cut the tip to the pattern. Now trim the bulky part of the tip down quite thin. Be careful not to round the tips until after the actual carving is completed.

Measure up the rear edge of the blades 1½ in. each side of the center hole and carve away toward the center until the hub is $\frac{5}{16}$ in. deep at the center. Sandpaper until the propeller is smooth, and balance it carefully.

The propeller shaft is No. 8 piano wire and, when completed, is 1 in. long. Bend a rubber hook on one end, pass the shaft through the center hole, and bend a tight loop in the other end. Force the tight loop into the wood at the hub to key the propeller in place. Touch it with cement. A very small washer could be cemented to the hub on the rear side. Usually you can get these washers from a clock repair man or a gunsmith.

The motor is three strands of $\frac{1}{32}$ by $\frac{1}{8}$ in. model airplane rubber.

THE model can, of course, be wound by hand and with this method can be safely given 300 turns, but you will certainly want to use a winder on it because by stretching the motor out to two and a half times its normal length you can give it 700 turns and get a much longer flight. Put a small S-shaped hook of No. 8 wire at the rear for use with a winder.

Winders may be purchased from model airplane supply houses. A small breast drill with a hook clamped tightly in the jaws makes an excellent winder.

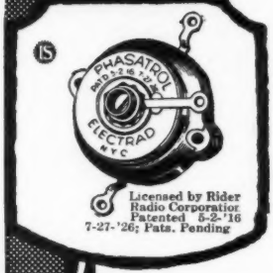
To fly the model, pass a rubber band over the fuselage and under the wing to hold the clips in place. Adjust the wing until the model makes a smooth glide. The farther back the wing, the steeper the glide, but you want the model to make the shallowest glide possible without stalling, so adjust it accordingly. Wind the motor and launch it level and very easily. These models can be flown outside, but only in the quietest of breezes, as they are so light that any wind has a powerful effect upon them.

After you have gained experience with the simple and easily built white pine model and have seen what an excellent flyer it is, you will certainly want to make a very light, advanced model. Follow the same design closely but make the parts to the dimensions shown in parentheses on the drawing and, of course, substitute balsa wood for pine. You will be amazed at the results.

A WORD about balsa wood: It is lighter than cork and so soft that you will crush it in your fingers or cut it with thread if you are not careful. Have your knife sharp, otherwise you will make ragged cuts.

In making the model in balsa wood, the main difference is in the cross sections of the various members, as balsa is only one half as strong as white pine.

The fuselage is ⅛ by ¼ in. balsa. Smooth it lightly with fine sandpaper and round the corners slightly. Give the stick a coat of banana oil. Prepare the wing clips, the propeller hanger, hooks, and cans in the same manner and of the same wire as on the white pine model. For binding use a split silk thread. By untwisting the thread, you will find it is made up of smaller strands. Use one of these smaller strands for all binding; partly because that will keep you from damaging the soft wood and partly because these wisps of thread are amply strong. All bamboo parts are made in the same manner as the first model except that the cross section of the bamboo is $\frac{1}{64}$ in. by a scant $\frac{1}{32}$ in. The wing spars are $\frac{3}{32}$ by ⅛ in. with the corners well rounded. When bending the dihedral in the spars, soak them well and heat carefully, as balsa takes fire easily and, once on fire, will smolder away. Also, the wood breaks more easily. (*Continued on page 137*)



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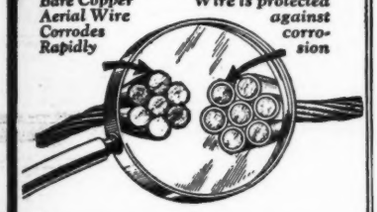

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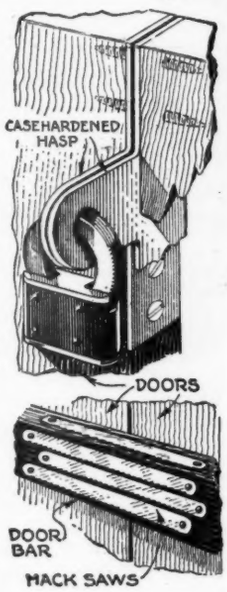
To make the door burglar-proof, I sawed two hasps as shown from ⅛-in. cold-rolled steel plate. They were then case-hardened by heating them to a cherry red and dipping them into potassium cyanide; reheating and redipping three or four times until the hardening extended ½ in. deep or more, so that they are file-proof and saw-proof. The padlock was protected by being chromium plated over the entire lock and U-bolt—and I don't think anybody will cut it with anything short of an acetylene torch!



Special hasps and saw-reinforced bar.

Having gone thus far, I thought I might as well provide additional security at night when the family is in the house. So a bar was made from a piece of 2-by-4-in. pine, and heavy iron cleats were bolted to each side of the door frame for this to rest in.

"No good," you will say, since it will be easy to cut through the bar with a saw inserted in the crack between the two doors. But—half a dozen hack saw blades picked up in a machine shop eliminated that possibility. These are 18-in. blades of self-hardening tungsten steel, discarded from a power saw. One was nailed to the edge of the wooden bar, and two on each side, the nails being driven through the holes in the ends of the blades. Smaller blades and more of them might have been used if the heavy machine saws had not been available.—CLYDE BAKER.

Monoplane Flies Indoors

(*Continued from page 136*)

For the outline of the tail use the same split thread as for binding.

The propeller blank is cut from balsa in the same manner as white pine, but the hub should be 3/16 in. thick instead of ⅛ in. Cement the shaft in place well so the rubber will not pull the wire through the soft wood.

The balsa model is very much lighter and consequently will fly on two strands of ½ by ⅛ in. rubber. This motor will take safely 1,100 turns with the winder, hence the greater flying ability of the balsa model. The balsa model, of course, due to the delicacy of the parts, is somewhat harder to assemble.

The writers' white pine model weighed .38 ozs., the balsa model, .25 ozs. The white pine model under good conditions in an outdoor test flew 2,200 ft., remained in the air 100 seconds, and attained an altitude of 150 ft. The balsa model, with the power increased to three strands of ½ by ⅛ in. rubber to enable it to withstand better the outside air currents, flew 5,000 ft., and remained in the air 180 seconds.

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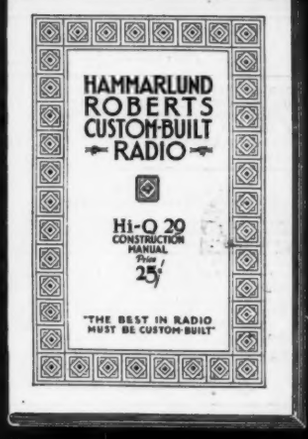

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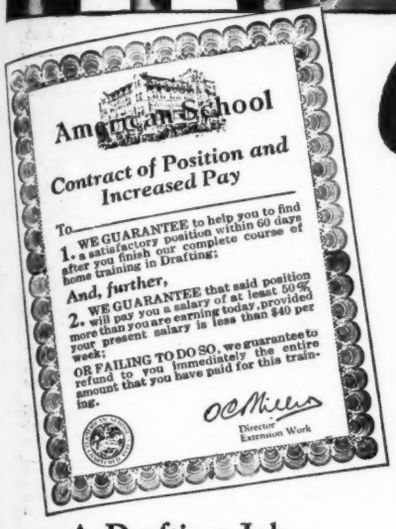
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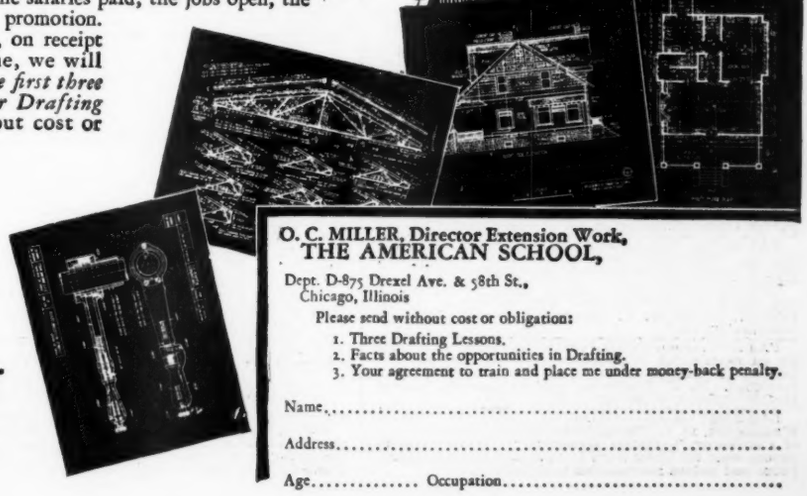

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MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

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AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marui Company, Tribune Bldg., New York.

Salesmen and Agents Wanted

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F., St. Louis, Missouri.

AGENTS. $60—$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A. N. Clark, Chicago.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

A BUSINESS of your own—Making Sparkling Glass Name and Number Plates, Checkerboards, Signs. Big Book and Sample free. E. Palmer, 513, Wooster, Ohio.

CALIFORNIA perfumed beads selling like hot cakes. Agents coining money. Big profits. Catalog free. Mission Factory, R 2328 W. Pico, Los Angeles, Calif.

SUCCEED With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog, circulars free. C. Thaxly Co., Washington, D. C.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

$50.00 WEEKLY easy, applying gold Initials on Automobiles. No experience needed, $1.45 profit every $1.50 job. Free Samples. "Ralco Monograms," 1041 Washington, Boston, Mass.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

DON'T sell for others. Employ agents yourself. Make your own products. Toilet Articles, Household Specialties, etc. 500% profit. Valuable booklet free. National Scientific Laboratories, 1970W Broad, Richmond, Va.

MAKE $1000 before Christmas selling exclusive personal Christmas cards, Steel engraved designs. Expensive Sample Book free. Wetmore, Janes and Sugden, Rochester, N. Y.

AGENTS—Be a thousand miles ahead of competition. Patented product Housewives want. Commission in advance if wanted. Vice-President, Box 929, New Orleans, La.

$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

PUNCHBOARD Salesmen. It's easy to earn repeat commissions with the "Lincoln Line." Merchants everywhere use Punchboards. Someone sells them! Why not you? Big pay every day. Catalog Free. Lincoln Sales Co., 9 South Clinton, Chicago, Dept. G.

AGENTS—Steady income. Large manufacturer of handkerchiefs and linens, wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 21 Main St., Brooklyn, N. Y.

BIG bunch mail. Year 15c. Catalogues, magazines. Kentucky Agency, Covington, Kentucky.

BIG pay every day, showing Nimrod's All-Year Seller Dress, Work, and Flannel Shirts, Overalls, Pants, Sweaters, Underwear, Pajamas, Leather Coats, Lumberjacks, Playsuits, etc. Experience unnecessary. Big Outfit FREE, Nimrod Co., Dept. 25, 4922–28 Lincoln Ave., Chicago.

WE HAVE a line of goods for which every man in America is a prospect. Can be handled with tremendous profit by any salesman now selling to men. $20.00 Outfit Free. Address Dept. 723, Sales Manager, 844 West Adams, Chicago.

SALESMAN handling hardware; paint; sporting goods and automobile accessory dealers, for fast selling sideline specialty; commission basis. Manufacturer: 1186 Grove Street, Irvington, New Jersey.

$12.00 DAILY Showing New Linen-Like Tablecloth. Wash like oilcloth. No laundering. Sample free. Bestever, 118 Irving Park Station, Chicago.

LOID-LAC Amazing New Auto Refinishing Discovery. Not a Paint, Polish, Cleaner or Wax. Restores Colors and Finish to Old Cars in thirty minutes! Greatest Automotive Development in years. Make it yourself with my simple, Guaranteed Formula. Today's Fastest Money-maker. Write or wire for detailed exclusive offer. $50,000.00 Business for $50. Grasp today's opportunity today! Loid Miller, Industrial Chemist, Tampa Florida.

AMAZING New Glass Cleaner offers you $15 a day sure! Cleans windows, windshields, show cases, etc., without water, soap or chamois. No muss. Easily demonstrated. Housewives, motorists, garages, stores, institutions buy on sight. Write for Special Introductory Offer. Jiffy Glass Cleaner Co., 2196 Monmouth, Cincinnati, O.

SELL Household Brushes. Sample Case Outfit and credit furnished. You pay when goods are sold. National Fibre Broom Co., St. Louis, Mo.

LARGE CONCERN has opening for Representatives to sell guaranteed hosiery. Earnings $50.00 weekly. Samples furnished. GOLD BOND HOSIERY, Dept. 2010, 1011 Chestnut, Philadelphia.

ATTENTION!!! Collect and keep $6.00 every order. Make from $60 to $180 every week. Two suits or suit and overcoat $27.95. Satisfaction guaranteed. Big swatch outfit free. LaSalle Gold Seal Clothes, 527 Broadway, Dept. 68, New York.

$4.00 PROFIT On $5.00 sale—"Free sample." New specialty. Money getter. Every storekeeper, doctor buys quickly. Experience unnecessary. Territories open. Federal Association, Hartford, Conn.

AGENTS: Buy for one cent a package 50-cent size extracts, pie-fillings, toilet articles. Russell, Harvey, Illinois.

STRANGE Invention! Pays $25 Daily. Keeps telephone and iron cords from tangling and kinking. Prevents iron scorching. Saves electricity. Samples free. Never-Knot, Dept. 11-F, 4503, Ravenswood, Chicago.

SHOW Us the Housekeeper Who Likes to clean stair-corners. Earn big money selling Corner Dust Shields. Write today. Ideal Stairway Equipment Co., Dept. PS., Canton, Ohio.

Read what BIG money these fellows have made in the RADIO BUSINESS

$375 One Month Spare Time

"Recently I made $375 in one month in my spare time installing, servicing, selling Radio sets. And, not so long ago, I earned enough in one week to pay for my course."
EARLE CUMMINGS,
18 Webster St., Haverhill, Mass.

$1597 In Five Months

"The N. R. I. is the best Radio school in the U. S. A. I have made $1597 in five months. I shall always tell my friends that I owe my success to you."
HENRY J. NICKS, JR.,
302 Safford Ave.,
Tarpon Springs, Fla.

$1164 Spare Time Profits

"Look at what I have made since I enrolled, $1,164—money I would not have had otherwise. I am certainly glad I took up Radio with N. R. I. I am more than satisfied."
HENRY R. HEIKKINEN,
123 W. Erie St., Chicago, Ill.

Over $1000 In Four Months

"My opinion of the N. R. I. course is that it is the best to be had at any price. When I enrolled I didn't know a condenser from a transformer, but from December to April I made well over $1000 and I only worked in the mornings."
AL. JOHNSON,
1409 Shelby St., Sandusky, Ohio.

I will show you too how to start a spare time or full time Radio Business of Your Own without capital

J. E. SMITH, President

Radio's amazing growth is making many big jobs. The world-wide use of receiving sets and the lack of trained men to sell, install and service them has opened many splendid chances for spare time and full time businesses.

Ever so often a new business is started in this country. We have seen how the growth of the automobile industry, electricity and others made men rich. Now Radio is doing the same thing. Its growth has already made many men rich and will make more wealthy in the future. Surely you are not going to pass up this wonderful chance for success.

More Trained Radio Men Needed

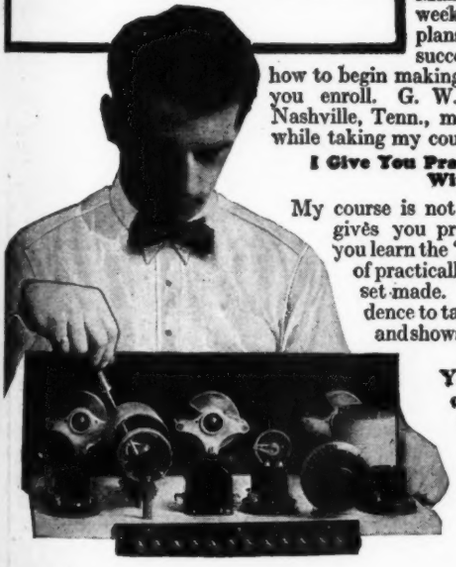
A famous Radio expert says there are four good jobs for every man trained to hold them. Radio has grown so fast that it simply has not got the number of trained men it needs. Every year there are hundreds of fine jobs among its many branches such as broadcasting stations, Radio factories, jobbers, dealers, on board ship, commercial land stations, and many others. Many of the six to ten million receiving sets now in use are only 25% to 40% efficient. This has made your big chance for a spare time or full time business of your own selling, installing, repairing sets.

So Many Opportunities You Can Make Extra Money While Learning

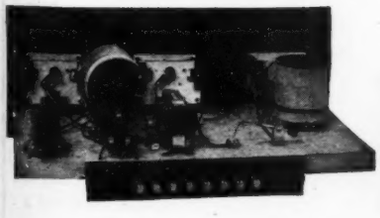
Many of our students make $10, $20, $30 a week extra while learning. I'll show you the plans and ideas that have proved successful for them—show you how to begin making extra money shortly after you enroll. G. W. Page, 1807-21st Ave., S., Nashville, Tenn., made $935 in his spare time while taking my course.

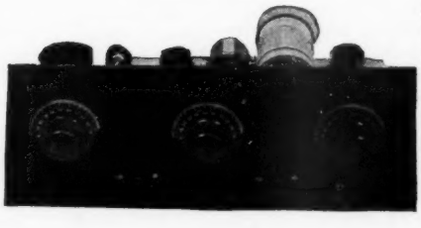
I Give You Practical Radio Experience With My Course

My course is not just theory. My method gives you practical Radio experience—you learn the "how" and "why" of practically every type of Radio set made. This gives you confidence to tackle any Radio problems and shows up in your pay envelope too.



You can build 100 circuits with the Six Big Outfits of Radio parts I give you. The pictures here show only three of them. My book explains my method of giving practical training at home. Get your copy!





I Will Train You At Home In Your Spare Time

I bring my training to you. Hold your job. Give me only part of your spare time. You don't have to be a college or high school graduate. Many of my graduates now making big money in Radio didn't even finish the grades. Boys 14, 15 years old and men up to 60 have finished my course successfully.

You Must Be Satisfied

I will give you a written agreement the day you enroll to refund your money if you are not satisfied with the lessons and instruction service when you complete the course. You are the only judge. The resources of the N. R. I. Pioneer and Largest Home-Study Radio school in the world stand back of this agreement.

Get My Book

Find out what Radio offers you. My 64-page book, "Rich Rewards in Radio" points out the money making opportunities the growth of Radio has made for you. Clip the coupon. Send it to me. You won't be obligated in the least.

This Book points out what Radio offers you. Get a copy!

Address

J. E. Smith, Pres.

Dept. 33M

National Radio Institute

Washington, D. C.

This coupon is good for a FREE copy of my Valuable Book. Mail it NOW!

J. E. Smith,
President.
Dept., 33M
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Send me your book. I want to know more about the opportunities in Radio and your practical method of teaching at home in spare time. This request does not obligate me to enroll and I understand no agent will call on me.

Name.....Age.....

Address.....

City.....State.....

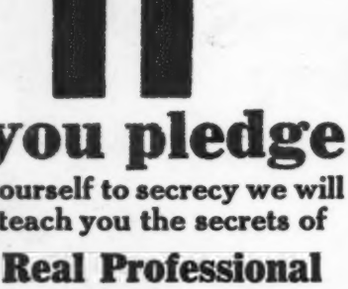
if-

you pledge

yourself to secrecy we will teach you the secrets of

Real Professional

Magic



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Learn to be a Magician

For the first time in the history of Magic the age-old, sacredly guarded secrets of the Mystic Art are being revealed. Now at last you can learn to be a Real Professional Magician. Yes, and you can learn this wonderful art *easily and quickly* AT HOME. You are taught the mysterious *Principles* by which the Professional Magician works. You are taught everything from wonderful impromptu effects to massive stage illusions. But before you can study, you must sign the Magician's Solemn Pledge of Secrecy. This means that you are getting the *guarded secrets* of the Magic Profession. Think of that!

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There's a big demand for Magic entertainment. Magicians get big money. Dr. Tarbell gets as high as $250 for a half hour's work. Unlimited opportunities for you!

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Write Today Send today for free Magic book, low prices and easy terms. Don't delay. Mail the coupon NOW!

Tarbell System, Inc., Studio 13-68
1920 Sunnyside Avenue, Chicago, Ill.

Gentlemen: Without any obligation send me your free literature and information all about your wonderful "Tarbell Course in Magic." Also tell me about your Low Prices and Easy Payment Plan.

Name.....

Address.....

.....*Age*.....

How to Reverse a Motor

By GEORGE A. WILLOUGHBY, E. E.

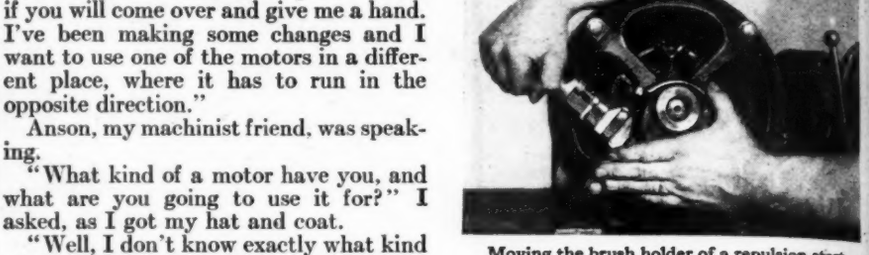
"SAY, George, I need a little help on a motor over at the shop. I wonder if you will come over and give me a hand. I've been making some changes and I want to use one of the motors in a different place, where it has to run in the opposite direction."

Anson, my machinist friend, was speaking.

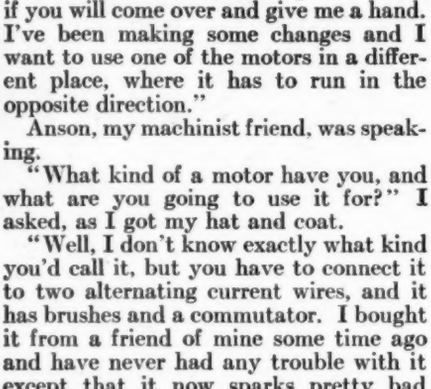
"What kind of a motor have you, and what are you going to use it for?" I asked, as I got my hat and coat.

"Well, I don't know exactly what kind you'd call it, but you have to connect it to two alternating current wires, and it has brushes and a commutator. I bought it from a friend of mine some time ago and have never had any trouble with it except that it now sparks pretty bad when it starts."

"That's easy," I said. "It must be a repulsion-start induction motor and the commutator probably needs a little sanding. We can take care of that."



Moving the brush holder of a repulsion-start induction motor to reverse the rotation.



Cleaning the commutator with sandpaper held over the end of a small block of wood.

When we reached Anson's shop, I could see that the commutator was dark and covered with carbon dust from the brushes, just as I had surmised.

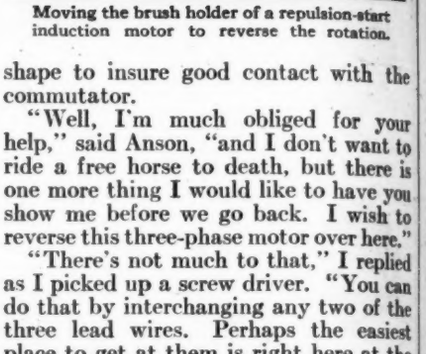
"It's a snap to reverse this motor," I assured him. "Just give me a wrench that will fit the head of this bolt clamping the brush holder in place. All we have to do is to loosen it and move it up to the top of the slot, and then perhaps move it back a little if the brushes spark after the commutator is clean and the brushes fit it." This adjustment was quickly made.

"Now give me a little block of wood and some fine sandpaper," I said, "and I'll show you how to sand the commutator as soon as you have the motor running."

With the sandpaper pulled over the perfectly smooth end of the block, I held the paper in contact with the commutator until it was smooth and bright. If the sparking had continued after this, I should have adjusted the brushes a little and fitted them to the commutator by lifting them, placing the fine sandpaper with the smooth side against the commutator, and working the armature back and forth by hand so as to remove enough of the carbon to make the ends of the brushes as smooth as possible and of a shape to insure good contact with the commutator.

"Well, I'm much obliged for your help," said Anson, "and I don't want to ride a free horse to death, but there is one more thing I would like to have you show me before we go back. I wish to reverse this three-phase motor over here."

"There's not much to that," I replied as I picked up a screw driver. "You can do that by interchanging any two of the three lead wires. Perhaps the easiest place to get at them is right here at the switch. You can just as well do it right now. Take the wire from the second terminal and leave it until you disconnect the first and put it in its place; then connect the second wire where the first was."



Reversing a three-phase motor by interchanging two of the lead wires at the switch.

Repairing Grease Cups

THE threads on the lower or bearing end of small grease cups wear in time to the point where they easily become crossed upon applying the cup. The chances are then greater of the cup's being loosened by vibration and becoming lost. Lay the worn part over the peen of a hammer as shown and strike it with a block of hard wood. This will expand the thin, tough metal of the cup quite evenly and as much as needed, in this way giving the grease cup a period of usefulness. —F. B.

The cup is expanded over a hammer head.

Salesmen and Agents Wanted

NO COMPETITION; new electric hot dog machine; sells $18.50; commission $6.50; ready buyers everywhere. Leonard E. Dickerson, Dept. R-1, Springfield, Mo.

IMPORT your own goods. German export magazine published in English, offers numerous bargains latest novelties; opportunities for obtaining profitable agencies. Copy 60c. Square Deal Supply, L-246 Fifth Ave., New York.

FOR Autos and Trucks "The Amber Eye" a new safety reflector prevents night accidents, reflects light from approaching car. Very efficient. Penetrates fog. Great demand, big profits for you. Sells $2.50. Send $1.00 for sample. Write. Hunt & Moore, New Haven, Conn.

IMPORTANT to advertisers! Are you deriving profit from your advertising? Write today for a copy of the "Quick-Action Advertising Rate Folder" showing "How You Can Use Popular Science Monthly Profitably." Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Song Writers

SONG Poem Writers—Bona fide proposition. Hibbeler, D10, 2104 N. Keystone Ave., Chicago.

SONG Writers: Let's see what you have to offer! Escher, Music Publisher, 1547 Broadway, New York City.

SONGWRITERS—Get in touch with Bell at once. Address D-2, 4718 S. Broadway, St. Louis, Mo.

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STAMPS, 100. All different, 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

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600 DIFFERENT $.50, 1100, $1.00, 2000, $3.50. Fred Onken, 630 79th Street, Brooklyn.

HIGH-CLASS Approvals. References Required. Pike's Peak Stamp Co., Colorado Springs, Colo.

NEWFOUNDLAND Postage Stamps. 40 standard varieties $1.00, 16-page Catalogue free. Rev. Butler, St. Georges, Newfoundland.

STAMPS, 105 China, etc., 2c. Album (500 illustrations) 3c. Bullard, Station BB, Boston.

FREE! 12 scarce Azerbaijan to approval applicants. Penna. Stamp Co., Greensburg, Pa.

RARE United States and foreign coins, war medals and decorations. German bill and catalogue, 10c. Alexis Mengelle, Colorado Springs, Colorado.

CALIFORNIA gold, quarter size; 27c, $\frac{1}{2}$ size; 53c. White cent and Catalogue, 10c. Norman Shultz, Salt Lake, Utah.

OLD Coins, large Fall selling catalog of coins for sale free to collectors only. Catalog quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont St., Boston, Mass.

STAMPS—15 Different Varieties Free—Try Our Special 1c Approvals Send 2c—Wood Patterson Stamp Company, Box 565, Pecos, Texas.

FREE—Early Bermuda, Canada listing 15c, to approval applicants sending two references, $1.47 (no checks) for Barbados, Palestine, Malta, Mauritius, etc., cataloguing $5. Satisfaction, or refund. Reuters, Fullerton, Calif.

100 AUSTRIA, 100 Germany, 100 Hungary for 25c. Weber, 1377 Park, Plainfield, N. J.

FREE—Surprise packet to approval applicants. Hovey, 17384 Beaverland, Detroit, Mich.

ALL Advertisers should not be without the important facts on Money Making. Write today for the "Quick-Action Advertising Rate Folder" which contains information of value to you. If you are anxious for quick profit returns, do it now! Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Stories Wanted

BIG demand for Photoplay and Magazine Stories. We revise, develop and copyright. Sell on commission. Established 1917. Booklet free. Universal Scenario Company, 414 Western & Santa Monica Building, Hollywood, California.

Telegraphy

TELEGRAPHY—Both Morse and Wireless—taught thoroughly and quickly. Tremendous demand. Big salaries. Wonderful opportunities. Expenses low: chance to earn part. School established fifty years. Catalog free. Dodge's Institute, H374 Hart Ave., Valparaiso, Ind.

Typewriters and Supplies

TYPEWRITERS—Factory Rebuilt Royals, Remingtons, Underwoods. New Royal, Remington and Corona Portables. New "Excellograph" Rotary Stencil Duplicator $37.50. Terms. Catalogue Free. Pittsburgh Typewriter Supply, 543—339 Fifth Ave., Pittsburgh, Pa.

Wanted

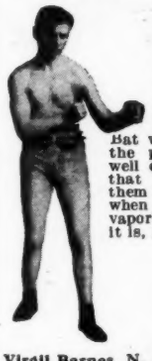
WANTED—Live foreman or mechanic or clerk in every factory in the United States to act as subscription representative for the most popular magazine in the world. Address Manager of Representatives, Popular Science Monthly, 250 Fourth Ave., New York.

PRIVATE party desires purchase elementary electrical or ground aviation Home study course with copyrights. Box 12, Popular Science, 250 Fourth Ave., N. Y. C.

COURSES WANTED—Used correspondence school courses. Anesiys, 2353 Main, Buffalo!

SAVED $340 in Gasoline
CHEVROLET 43.8 Miles Per Gallon
OLDSMOBILE 300 Miles of Free Gasoline
FORD 57 Miles on Gallon
BUICK 36 Miles on a Gallo
CHRYSLER 48 Miles Per Gallon
STUDEBAKER 32 Miles on Gallon
ENDS CARBON Without Touching the Engine

Who Else Wants to Save Gasoline?



Battling Nelson, The Durable Dane. Bat made 40 miles on a gallon with a roadster and 33½ miles a gallon with a touring car. Bat writes: "Most of the public know me well enough to know that I never bunked them in my life. And when I say your vaporizer is all you say it is, I mean it."

Virgil Barnes, N. Y. Giant Pitcher, says: "Words cannot express my delight with the Stransky Vaporizer. I left New York City after the close of the baseball season with a vaporizer on my Chrysler 60. When I arrived in Holton, Kansas, I found I had averaged within a fraction of 47 miles per gallon of gas."

H. H. Cummings has saved 1,905 gallons of gasoline on 50,000 miles. "I have used one on my 1922 Ford which I have driven over 50,000 miles," he says. "I am getting 30 miles a gallon where before I got only 12 to 14 miles a gallon."

A SOUTH DAKOTA man has discovered an amazing gas-saving invention now installed on over two million cars of every make. Already over ten thousand car owners say it increases gas mileage 25% to 50% . . . cleans out carbon without touching the engine . . . adds more speed and power . . . . and saves an astonishing amount of money in gasoline and repair expense. There is a model for every car, truck, tractor or gasoline engine. Anybody can install it in a few minutes.

This invention is based on newly-discovered facts about potential gasoline power that few car owners know about. For example, it is now found that the average man wastes at least 20% to 30% of his gasoline through improper combustion. And many more interesting discoveries, too detailed to mention here.

Read on the left what other car owners say about it. Then accept the inventor's special introductory offer. He will send you samples to test without obligation to buy. If you find it doesn't do for you what it has done for other car owners, he will pay a cash forfeit for the few minutes you've spent in testing it.

Don't send a penny now. Simply send your name in coupon below. J. A. Stransky Mfg. Co., P-730 Stransky Block, Pukwana, S. D.

MEN WANTED

Herrick made $157 in a day, letting Stransky vaporizers sell themselves. Territories open everywhere. Full or spare time. Check coupon below.

J. A. STRANSKY MFG. CO.,
P-730 Stransky Block, Pukwana, S. D.

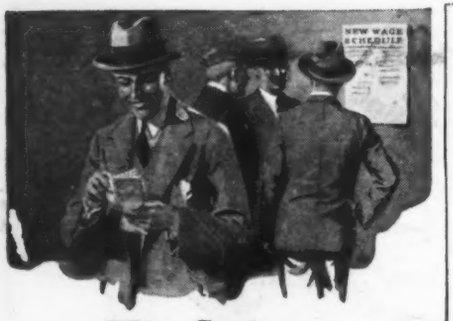
Yes, send me full description of this new way to save gasoline. This request does not obligate me in any way.

My Name is.....

Street.....

City..... State.....

( ) Check here if you want agent's proposition.



His Salary Was Raised

while others were reduced

"Up to the time I enrolled for a course with the International Correspondence Schools, I had only a grade-school education. Since enrolling, I have advanced to a much better position, where my salary is nearly four times as much as I was making previously. I would not be able to hold my present position had I not taken your Course. Recently I received a nice increase in salary, while other men were being reduced."

Read that last sentence again—"Recently I received a nice increase in salary, while other men were being reduced."

There could be no better proof of the value of an I. C. S. course than that. It shows that the trained man is given preference over all others and paid more money, even in slack times, if his work deserves it. It shows that there are always bigger, better jobs open for men who have the foresight to prepare for them in spare time.

Why don't you study and get ready too? We'll be glad to help you if you will only make the start.

Choose the work you like best in the coupon below; then mark and mail it to the I. C. S. today. This doesn't obligate you in the least, but it will bring you information that will start you on a successful career. This is your opportunity.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7699-E Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the subject *before* which I have marked X:

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☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
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If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal

$1000 Profit for Agents!

An All Year Round Income without Investment

Everyone is ever thinking of jewelry as gifts for dear ones or for themselves—everyone is wondering not only what to select but how to conveniently pay for it. Show them our plan of easy payments. Show how easy it is to have a beautiful diamond ring, watch, silverware, etc., and have twelve months to pay. Our agents earn from $50.00 to $200.00 weekly, selling on cash or credit. We put you in the jewelry business for yourself and carry the stock for you. You make no investment. You merely take orders and earn very liberal commission.

Send for FREE *Outfit* TODAY

Write for complete free outfit, which contains catalog in colors, order blanks and full instructions. We send by return mail everything to start you earning without delay—Write today.

Sterling Diamond & Watch Co., Inc., Dept. A-221
1540 Broadway, New York, N. Y.

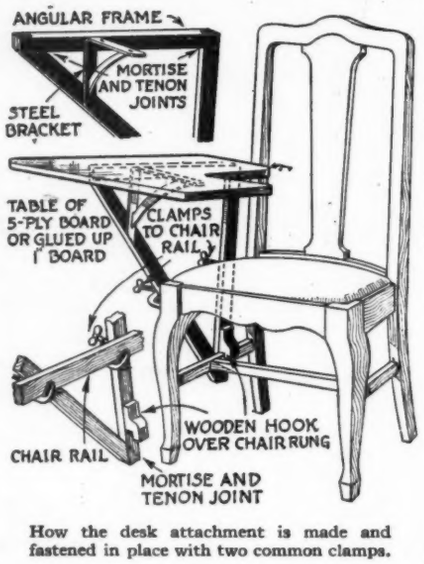
Arm Board Turns Chair into Desk

By E. M. LEEDS

THE desk attachment illustrated can be easily built at slight expense and attached to almost any ordinary chair.

For the top, glue to a piece of 1 by 6 in. pine 2 ft. 6 in. long, two widths of 1 by 10 in. stock 1 ft. 5 in. long, so that the desk can be shaped up to a width of 1 ft. 9½ in., and a length in the broad part of 1 ft. 4 in., with the corners rounded to a radius of 1 in. Or, better still, use a single piece of 5-ply veneer stock, which will not warp.

For the triangular support, use 1⅛ by 2 in. stock, S4S, that is, dressed on all four sides. This is generally 1/16 by 1½ in. when smoothed up. For the upright stile, cut a piece 1 ft. 7 in. long. To mark for the mortise, gage on one end two lines ⅜ in. and 1/16 in. respectively from one face, and extend them down the edges



How the desk attachment is made and fastened in place with two common clamps.

1½ in. Bore a ¼-in. hole edgewise through the piece at the bottom of the mortise, and, ripping in the waste wood, cut the sides. Trim the bottom smooth with a chisel.

Cut the rail stock 1 ft. 10 in. long, and on one end cut a tenon corresponding to the mortise in the stile.

Cut the brace 2 ft. 6 in. long. Assemble rail and stile without glue, square them, and lay the brace over the ends with the lower edge flush with the inner corners. Guiding by the brace, mark the bottom of the mortises in the rail and stile and guiding on the latter, mark the tenon shoulders of the brace. Gage the edges and cut the mortises and tenons on the three pieces. See that they fit and glue them together.

To assemble the brace with the top, lay the top upside down on the floor and draw a line 1 ft. 10 in. long on the underside, as follows: begin 1 in. in from the corner marked A and continue to a point 3 in. away from a line drawn as the continuation of the inside edge of the arm rest. Stand the support on the top with the inner edge on *(Continued on page 146)*

Complete this Drawing

Test your Ability

If you like to draw, let your talent make your fortune. Opportunities in this field have never been better. Drawing is easy to learn the "Federal Home-Study Way." Learn from over fifty famous artists. The course includes illustrating, cartooning, lettering, poster designing, window card illustrating, etc. Get on the "Road to Bigger Things." Complete the drawing above in pen or pencil. Write your name, age and address on the margin of this ad. Tear it out and mail to us TODAY.

Federal School of Illustrating

11148 Federal School Bldg., Minneapolis, Minn.

Your Head is worth $100 a week

If you are a reliable and honest man and willing to work, I will put in charge of my business in your locality and show you how to earn $100 a week. Our company, an old, established Ohio Corporation offers you a permanent, steady income for simply inspecting homes, factories, warehouses, schools, theatres, hotels, farm buildings, etc., in your neighborhood and writing down the orders. We deliver and look after collections.

A BUSINESS OF YOUR OWN

We will set you up in business and advertise you. No capital for stock required—draw from our factory stock. No experience necessary—I show you everything. Your income can start as soon as appointment is made. Checks mailed every Saturday. Write today to *Ray C. Hahn, Sales Manager*

FYR-FYTER COMPANY
92-L Fyr-Fyter Bldg. Dayton, Ohio

Agents—Salesmen

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A whirlwind seller for agents. Costs $3.60 dozen. $36.00 gross. Write today for complete details.

All-In-One Sales Co.
Dept. S-11 4648 Grand Ave.
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Sample, 50c

only $1.00 DOWN

10 Day FREE Trial

You can have a genuine L. C. Smith (the world's only ball bearing typewriter) for $1 down. Lowest price ever offered! Easiest terms. All the 1928 operating attachments. Re-newed. GUARANTEED FOR 5 YEARS. $1 down and we ship. No delay. No red tape. 10 day Free Trial. Free Typewriter Course. Tools. Waterproof Cover if you act now. Write for $1 down offer and free manual.

SMITH TYPEWRITER SALES CORP.
53-B - 360 E. Grand Ave. Chicago, Ill.

NOW--End Figuring Worries

Sensational New Invention Saves You Money, Time, Trouble, Brain-Fag—Every Day!

No more of this—

—if you mail the Coupon!

New!

Revolutionary!

Worth twenty times its cost to everyone who uses figures! ADDOMETER adds, subtracts, multiplies. Solves any problem instantly. Fits your pocket. Read details below, then mail coupon at once for machine on

FREE 10 Day Trial

Amazing New Portable

ADDING MACHINE

Does all the work of bulky, expensive, $300 machines — *Costs only* $10 COMPLETE

THINK OF IT! No more drudgery! No more costly errors! No more fretting, fuming, or struggling over figures! Instead, the correct answer to every problem—instantly and automatically! And all at a cost of only $10!

Sounds impossible? It's not; it's an actual *fact!* For that's exactly what ADDOMETER offers you. A lifetime of dependable figuring service—at no more than the cost of a fountain pen! And we're ready to prove it by sending you a machine absolutely FREE for 10 days' trial! (See the coupon.)

A Mechanical Marvel

Undoubtedly one of the most ingenious inventions in years, ADDOMETER is the very figuring aid you have always wanted. It ADDS — clear up to 99,999.99⅞—quick as a flash! SUBTRACTS with the same speed, agility and ease of operation as it adds! Even adds and subtracts FRACTIONS in units of ⅛! And it MULTIPLIES as easily as the most costly machines. You need it *right now* to total invoices, take inventory, balance ledger accounts, figure discounts, or perform 1001 other useful, everyday computations. And you can depend upon ADDOMETER to always give you the right answer—instantly! It's almost magical!

A wonderful aid "out on the job."

Employs New Principle

Revolutionary in principle as well as in price, ADDOMETER has been acclaimed by experts the neatest, most compact and remarkable adding machine ever invented. It works entirely without the use of keys or awkward levers. Yet it is lightning fast and never makes a mistake. Shows total always visible. It clears instantly. Every action is simple—direct—automatic. Anyone can operate it like an expert in 5 minutes' time!

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Equip all your employees at small cost.

A Machine Everybody Should Own

ADDOMETER performs a useful, necessary service in *your* daily life. Does all your figuring for you quickly and accurately. Eliminates mental strain, prevents costly errors, saves you time and money every hour of the day. Even if it sold for $100 or more you shouldn't be without it! At only $10 you couldn't buy a handier helper. Yet that's all ADDOMETER costs—and you needn't pay a penny until you've used it for 10 days!

AGENTS - - DISTRIBUTORS!

ADDOMETER is the biggest selling sensation in years. Everybody buys — on sight! Red hot prospects everywhere. Write at once for details of **Guaranteed Profits Sales Plan** and special **FREE TRIAL Offer!** Do it NOW! Address your inquiry to Mr. W. C. Edwards, Sales Mgr. (Do not use the coupon.)

FREE EXAMINATION
Send No Money—No C. O. D.

We want you to have ADDOMETER for 10 days' FREE TRIAL in your home or office. So we are offering it on our famous "No Risk" plan. We ask NO money in advance—NOTHING on delivery—NO deposit of any kind. Simply fill out and mail the coupon and we'll send you a machine postpaid. Try it! Test it! Use it as your own for 10 full days Then if satisfied, remit only $10 in full payment. Otherwise return the machine and we'll consider the transaction closed. Isn't that offer fair? Isn't it convincing? Then by all means investigate at once. Send that coupon for your machine—NOW—TODAY! Get it in the very next mail!

NOTE: *ADDOMETER is made in 3 models. Every machine fully guaranteed. Fractional Decimal Model A (decribed in this announcement) counts to 99,999.99⅞. Ideal for general use. Standard Decimal Model B counts to $999,999.99 (no fractions). Designed for folks who deal in very large numbers. Lineal Measure Model C counts up to $999,999 feet 11⅞ inches. Particularly valuable to architects, etc. Be sure to indicate Model desired.*

THIS COUPON BRINGS MACHINE

ADDOMETER COMPANY, Dept. 158
(Division Reliable Adding Machine Corporation)
184 W. Washington St., Chicago, Ill.

Gentlemen: Please send me an ADDOMETER (model indicated below) for 10 days FREE TRIAL on your special "No Risk" plan. If entirely satisfied I will remit $10 in full payment within ten days. Otherwise I will return the machine to you.

☐ *Model A* ☐ *Model B* ☐ *Model C*

NAME.....

ADDRESS.....

Clip and mail this coupon NOW. Please accompany coupon with your business card or letterhead, or give name of one reference (kept confidential). This is important to us. THANK YOU!

5% OFF to save bookkeeping — if you prefer to send cash with order. Money back, of course, if not entirely satisfied with your machine.

ADDOMETER COMPANY, Dept. 158 184 W. Washington St. CHICAGO, ILLINOIS

Here is Edwin McTeer (address on request) and some of his work. The crude pen drawing was made before he had any training and the striking story illustration (worth $100) was made after he took the Federal Home Study Course.

He did it—Why don't you?

Edwin McTeer is only one of the hundreds of young men (and young women, too) who are succeeding in commercial art with the help of the practical training offered by the Federal Home Study Course. Well trained artists earn $50, $75, $100, $150 a week and more.

Success in Commercial Art

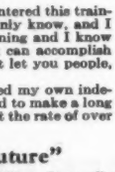
begins with a liking for drawing and the ambition to follow through with the right training. Mr. McTeer was thirty years old when he clipped a coupon like the one at the bottom of this ad, and took up the Federal Course. He progressed rapidly, increasing his earnings each year until, at the end of five years he is making around $10,000 a year. Read what he wrote us:

"I was not very talented when I entered this training with you people as you certainly know, and I had not even had high school training and I know any one with a love for the work can accomplish even more than I if they will just let you people, the Federal Schools, help them.

"I suppose you remember I opened my own independent commercial art studio, and to make a long story short, my earnings are now at the rate of over $10,000.00 a year."

Send for "Your Future"

If you like to draw—send for book "Your Future" and find out what amazing progress you can make with the right art training. Use the coupon now, giving age and occupation.



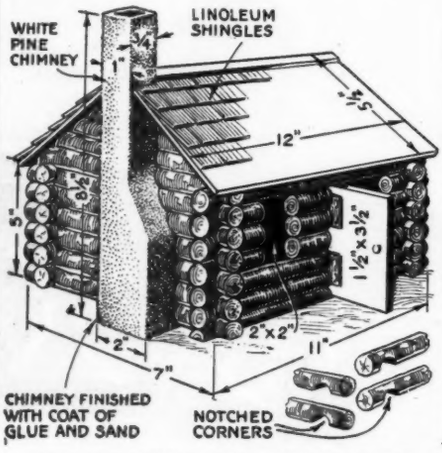
Federal School of Commercial Designing

1360 FEDERAL SCHOOLS BLDG.
Minneapolis, Minn.
Please send me "Your Future."

Name .....
Address .....
Present Occupation .....
Age .....

How to Build a Realistic Miniature Log Cabin

TINY log cabins for use either as mantel ornaments or as toys can be made quite easily from branches of trees, or wooden curtain rods or dowel sticks. I made the cabin illustrated of ⅝-in. curtain rods—14 pieces 11 in. long and 18 pieces 7 in. long. The cabin is 7½ in.



An ornamental log cabin model constructed of ⅝-in. curtain rods, white pine and linoleum.

high to the ridge; the other dimensions appear on the drawing.

The chimney is sawed from a ¾ in. thick piece of white pine and covered with a good grade of glue and coarse sand. The roof, which is of ¼-in. 3-ply veneer, is "shingled" with pieces of linoleum cut 2 in. long and random widths from ½ to 1¼ in. These are glued and nailed underside up to give a weathered appearance.

The door is ½ in. thick pine. Windows are cut beside it and in the end opposite the chimney.—CARL G. ERICH.

How to Clean Plaster Casts

PLASTER of Paris statuettes or busts can be cleaned by dipping them in a thick liquid starch, allowing them to dry, and brushing off the starch. The greater part of the dirt is removed with the starch and in many cases the surface of the plaster looks as clean as when it was new.—R.C.S.

Arm Board for Chair

(*Continued from page 144*)

this line, and drive a fourpenny finishing nail through each end into the top. Turn the top right side up and drive sixpenny finishing nails from above into the rail, setting them for puttying.

Six inches from the forward end of the rail, screw a 10 by 12 in. wrought steel shelf bracket to the underside of the top and to the rail and brace. Cut off the projecting lower end.

Try the table on the side of the chair to which it is to be attached, and mark the position of the rung under the seat. Glue to the stile a wooden hook or notched cleat to fit over the rung and glue pieces of felt to the stile and brace where they bear against the chair rail. Sandpaper smooth and finish as desired.

New Easy Way to LEARN AUTOS AT HOME!

Earn Up to $100 a Week

Stop just *wishing* for a good job with big pay. You'll never get it that way. Let me train you at home, my new, easy "JOB WAY"—let me prepare you for a wonderful future in AUTOS, the World's Biggest Business, where trained men—Auto Experts—get $50, $75 and $100 a Week.

Keep Your Job

No need to quit your job. You can learn autos better, quicker and cheaper this new, easy method. Only your spare time needed. I teach you everything you need to know and show you how to make big, extra, spare time money while training—then help you get a good job or go into business for yourself.

At Home

Clip coupon for my FREE Auto Book. Read how "Job-Way" Training has lifted scores of men—many with very little education and no previous experience—out of dull, tiresome, poorly paid jobs into the big money class. "Job-Way" is easy—if you're between the ages of 18 and 50 and can understand plain, simple, everyday words, get my book and see what I can do for you.

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Name _____
Address _____
Town _____ State _____
Age _____ Occupation _____

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Writes with ink smoothly, answering purpose of pen and pencil. Never blots, scratches, leaks or dries. Makes 3 carbon copies at one time with original ink.

A HARD SMOOTH BALL LIKE 14K GOLD POINT

THE WRITING HEMISPHERE

THE PENCIL POINTED PEN $1.50

SAME SIZE AS $7 AND $8.75 FOUNTAIN PENS

SEND NO MONEY. Pay postman $1.50 plus postage. Sent prepaid if cash is sent with order. Money back if not satisfied, within 10 days.

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AGENTS Send for Inkograph or write for Sales plan booklet. Big value, — sells on sight — no investment.

$4.99 .22 Cal. Blank Automatic

WITH 100 CARTRIDGES Free!

You need no license or permit to own this 6-shot Automatic. Use for fun or self-defence. No Permit Required. Keeps away tramps. Frightens thieves, scares away dogs—a real home protector. Fool your friends. Same as an expensive automatic in construction, finish, appearance, durability; automatic magazine loading and ejection of cartridges. Instantly and powerful report. Guaranteed absolutely safe. Send no money. Pay expressman $4.99 for automatic with 100 cartridges. JENKINS, 621 Broadway, New York, Dept. 91J11

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Sample Copy of OPEN ROAD for BOYS Magazine . . . 50 pages thrilling stories, pictures, sports, mystery, etc. Free membership in WINNIT CLUB, badge-button, big outfit, catalog and new plan for getting easy money and swell prizes. Big surprise, too. ALL FREE! No obligation.

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A remarkable book written by one of America's noted artists, called: "*Commercial Art and Cartooning.*" No long drawn out correspondence course. This One Big Book Explains Everything. Contains 125 illustrations—14 chapters.

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$2.00

COMMERCIAL ART AND CARTOONING

OGILVIE PUBLISHING CO.
57 Rose St. Dept. 96 New York

A definite program for getting ahead financially will be found on page four of this issue.

MOVIES *teach you* ELECTRICITY

Actual Motion Pictures Prepare You at Home for Bigger Pay

EASIEST, surest of all ways to learn electricity is this amazing new method of ***teaching with movies!*** Actual motion pictures, in your own home, with projector and films we furnish, prepare you in spare time for big pay rewards in this ever-growing field.

You know how easy it is to look at movies! In no other course can you get the big advantages of this fascinating instruction method. No dry text book matter! Live, fascinating pictures of ***electrical machinery in operation!*** Animated diagrams show you exactly how electricity operates, how you can control it. ***Projector we furnish, at no extra cost, is so simple anyone can operate it at once, without experience.***

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Our complete course gives you thorough and practical preparation for electrical work of all kinds. Our employment department helps you locate a Big Pay Job in Aviation Electricity, Radio, Switchboard Work, Sub-Station and Power Plant Operation, Automotive Electricity, Wiring, Contracting, Merchandising, etc.

You are personally guided and helped by practical engineers and educators, including: Bruce Rogers, M. S., Western Electric Company; J. A. Shimek, M. E., DeVry Corporation; A. P. Hollis, formerly Director Visual Education, University of North Dakota; W. N. Littlewood, formerly instructor University of Wisconsin, and others.

You Get This DeVry Projector

Standard Model DeVry motion picture Projector, value $75.00, and thousands of feet of film, supplied to every student for use during the course at no extra cost. So simple anyone can operate it, immediately. Uses ordinary light connection, farm lighting equipment, or automobile battery. ***Gives clear, brilliant, flickerless movies right in your own home.***

Drafting Set Given

Complete professional outfit, including the set of fine instruments in plush lined case shown here, and in addition drawing board, rules, T-square, scale, paper, etc. Everything that is necessary for this ***complete course in electricity with drafting,*** at no added cost.

What a Practicing Engineer Says:

Charles E. Fitz, M. E., E. E., formerly associated with Steinmetz, says: "I am amazed at how clearly and simply you explain the facts about electricity. The points are ***so much easier to grasp*** than by the usual methods of instruction that ***the student must make quicker, surer progress.*** Your whole course seems to me by far the best method of getting thorough preparation for practical electrical work."

We Pledge to Help You Earn More or You Don't Pay a Cent!

You receive this pledge in writing immediately upon enrollment: "When you graduate from your complete course in Electricity you must be convinced that you have received the training and employment service necessary to obtain a better position than you now have, ***or we will refund your tuition,*** provided you give notice within 30 days after forwarding final examination papers." You take no chance. We give you what we say we will, or refund your money.

FREE ***THREE LESSONS AND OUR NEW BOOK "The Film Way to Bigger Pay in Electricity"***

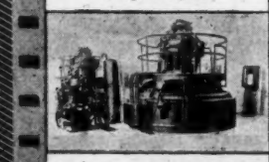
Send coupon now and we will give you, absolutely free, three lessons showing exactly how motion pictures are used in training. Our new book, fully illustrated, shows how we train you for these bigger pay jobs. You can't lose, ***unless you fail to act.*** Get this free material now, by sending coupon at once.

Electricity driving rollers in sugar mill

Twin Tandem electric unit in steel mill

Electric furnace used in refining metals

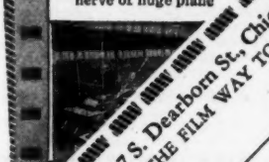
Section of test room in telephone plant



Hydro-electric plant making current from waterfall

Telephone "line finder" of Bell Company

Electricity is brain and nerve of huge plane



The NATIONAL SCHOOL *of* VISUAL EDUCATION

"The Film Way to Bigger Pay"

National School of Visual Education, Dept. 11-F 537 S. Dearborn St., Chicago, Ill.

Gentlemen: Please send without obligation to me, your book, "THE FILM WAY TO BIGGER PAY IN ELECTRICITY" and Three Free Lessons.

Name_____ Age_____

St. or R.F.D._____

City_____

State_____

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Mail this Coupon At Once!

Caruso's

Secret Revealed!

A post-mortem of Caruso's throat showed a superb development of his Hyo-Glossus muscle—the basic reason for his tremendous vocal power.

Strengthen your Hyo-Glossus

-and YOUR Voice will be Powerful, Rich, Compelling

YOU have a Hyo-Glossus muscle in your throat. But you never use it because the nerve center in the brain controlling this muscle is dormant.

The great secret of isolating this great vocal muscle was discovered by Eugene Feuchtinger, A. M., famous European musician-scientist, who has now made his simple scientific method of voice development available to everyone. It is ideally adapted to correspondence instruction. The exercises are silent. You can practice them in the privacy of your own home. The results are sure.

100% Improvement Guaranteed

In fact, we guarantee to refund your tuition if your voice is not improved 100% in your opinion. You alone are to be the judge.

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You will do yourself a great and lasting good by studying this book, "Physical Voice Culture". It may be the first step in your career. Do not delay. Mail the coupon today.

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Please send me FREE your handsome, new book, "Physical Voice Culture". I have put X opposite the subject that interests me most. I assume no obligation whatever.

☐ Singing ☐ Speaking ☐ Stammering ☐ Weak Voice

Name.....

Address.....

.....Age.....

Solving the Mystery of Twins

(Continued from page 41)

Eleanor was adopted by a family living at Bay City, Michigan. Neither sister saw the other or knew of her until a few months ago when a women thought she recognized Georgiana on a South Bend bus. In reality it was Eleanor. Explanations followed and now Professor Horatio H. Newman, distinguished biologist of the University of Chicago, is studying the case, which is of intense scientific interest because only the heredities of these children were alike. Their environments have been different almost since birth.

At the University of California, Professor H. E. Jones is setting up a "twin laboratory" for a most searching study. Apparatus will be provided for the exact measurement of all bodily and mental characters. No less than five hundred pairs of twins will be studied, from birth until adult life, if possible.

PROFESSOR JONES will include not only identical twins but some of those who are not so remarkably alike. How does science explain these, some of whom lack even the usual family likeness? These so-called "fraternal" twins are not really twins at all, in the sense of having sprung from the same original cells. They are merely ordinary brothers or sisters who happen to have developed simultaneously but from two distinct fertilized egg cells. Here there are no mental or bodily similarities more marked than between other members of the same family.

Among triplets and among those still rarer individuals who enter the world in groups of four, five, or more at the same birth, there probably exist the same two types as among twins. Some of the triplets and quadruplets are distinct individuals, whose separate germ cells merely chance to develop together. Among such are the famous Keyes quadruplets of Hollis, Oklahoma, girls of fourteen; three are dark-haired while the fourth is a blonde.

That others exist of the more interesting identical type is proved, however, by the Hanna sisters of Kansas City, triplets who at eighteen are as much alike both in mind and body as any two identical twins; by the Waggoner brothers of Union County, Tennessee, triplets who looked exactly alike throughout lives lasting over seventy years, and by numerous instances discovered by Dr. R. A. Fisher, of Rothamstead, England, in a recent study of 169 cases of English multiple births in 1924, 1925, and 1926.

TRIPLETS and quadruplets have been less studied scientifically than twins for the simple reason that they are so much rarer. Over the whole earth there is probably about one pair of twins for each two hundred ordinary births; one trio of triplets for each six thousand births; one set of quadruplets for every million births, and one birth of five children for every twelve or fifteen million births. Medical records contain a dozen or so instances of six living children born at once and two somewhat doubtful instances of seven.

Among other puzzles of heredity which the studies of twins and triplets are expected to help solve is whether the propensity to have twins is itself hereditary. Probably it is; physicians are sure, at least, that some parents are more likely than the average to increase their families by twos. Four sets of twins in one family, as far as is known, is the American record, jointly held by at least two families, while five pairs have appeared in each of several families in other parts of the world.

"HOW can he do it?" we always want to know whenever a magician performs some thrilling new feat. In a forthcoming issue an expert explains many magical illusions which have mystified us most. You won't want to miss this fascinating article.

Electricity at your finger ends

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity.

Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes.

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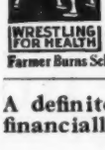

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A definite program for getting ahead financially will be found on page four of this issue.

JIMMIE, THIS THING WILL SELL! LET ME BORROW IT FOR THIS AFTERNOON.
THAT'S WHAT THEY CALL A KRISS-KROSS STROPPER- IT GIVES THE SLICKEST SHAVES EVER INVENTED
JIMMIE, THAT KRISS-KROSS STROPPER YOU LOANED ME A YEAR AGO - WAS THE START OF A $15,000 BUSINESS
I SHOULD HAVE KEPT IT AND GONE INTO THE KRISS-KROSS BUSINESS MYSELF

How I Started Making $5300 A Year

With a Borrowed Kriss-Kross Stropper

The True Story of A Man Who Found Himself Facing Failure And Then — by a Sudden Stroke of Luck — Discovered The Secret of Making Over $5000 A YEAR! Don't Fail to Read This Illuminating Article of Real-Life Success! It Should Prove An Inspiration to Any Man Who Wants to Make More Money!

By B. G. LOUGHREN

$200 the first week! $1000 in a single month! And over $5300 cash profit in a year!

When I sit down and look at those figures in my bank book, I can't help marveling at the strangeness of Fate. It was Chance—and Chance alone—that thrust this money-making opportunity into my path at the very moment I needed it most! I had been in the real estate business in Florida, when suddenly the "boom" collapsed! The immediate future looked gloomy, until one day when I dropped in to talk things over with a friend.

When I went into his office, he was at the wash bowl just finishing shaving, so I sat down at his desk where my eye fell on a little nickel-plated contrivance about half the size of my hand. There was something about it that aroused my curiosity.

NEW, REVOLUTIONARY INVENTION

"What's this thing?" I asked.

"That's one of those KRISS-KROSS razor stroppers," said Jimmie. "You've read about it in the magazines. I've only been using it a month but I'm getting the keenest shaves of my life, *all from the same blade.* Look here, I'll show you how it works."

Well, it certainly was a mechanical marvel. I hadn't seen anything as ingenious in years!

"I wish I could invent something like that," I said. "I'll bet the company that puts it out is coining money hand over fist."

"They are," said Jimmie. "Furthermore, they only sell through agents and demonstrators,—and those agents are making *plenty,* too! I sent for their proposition the other day just out of curiosity."

He handed me a letter with some sample order blanks attached. I read it through and then read it all over again.

"Jimmie," I said at last, "this thing sure will SELL—and they certainly give their men a generous split! Let me borrow your stropper this afternoon and see how many orders I can take!"

ASTONISHING PROFITS

That afternoon I got the surprise of my life. The first man I walked up to had read all about KRISS-KROSS in The Saturday Evening Post and said "Send me one" before I got half-way through my demonstration. By 4:30 I had 9 orders —and the next morning I got 11 more!

That sure convinced *me*—and I wrote the company that although they were not aware I was working for them, the only way they could stop me was by wire! . . . They wrote back—"Good work. Go to it." . . . Needless to say, I "went to it" in earnest and the end of the week found me with exactly $200 cash profit in my pocket.

A $15,000 BUSINESS ALMOST OVER NIGHT

The money I made that first week came easily enough—but after I got well started it became easier and easier. And then, before I knew it, I found that I was actually clearing as high as $1000 in the single month!

To-day I figure that I did a $15,000 gross business that first year—with profit of over $5000. And it all came from getting started with the right kind of a proposition. Success comes from giving the public what it wants and they surely have shown that they WANT KRISS-KROSS! Personally, I believe that it is the most astonishing "self-seller" I have ever seen and that the coming year will prove it the *greatest direct-selling item of all time!*

Mr. Loughren's experience is typical of the surprising successes of KRISS-KROSS representatives in all parts of the country. Practically every man finds himself making money faster and easier than he ever dreamed possible. Right now, due to our heavy Fall advertising program in Liberty, The Saturday Evening Post, Collier's, etc., there is room for more KRISS-KROSS representatives—to earn $30 a day and up. Find out about this opportunity to-day. No obligation. Just clip the coupon and mail it at once!

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KRISS-KROSS actually reproduces *with mechanical precision* the intricate diagonal stropping stroke of a master barber. Strops any make blade (except Durham Duplex), giving the keenest cutting edge that steel can take! Just insert blade and turn the crank for 11 seconds.

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Rhodes Mfg. Co., Dept. S-243,
1418 Pendleton Ave., St. Louis, Mo.

Please send me details of KRISS-KROSS Stropper with generous commission proposition you offer to representatives and agents, working full or spare time.

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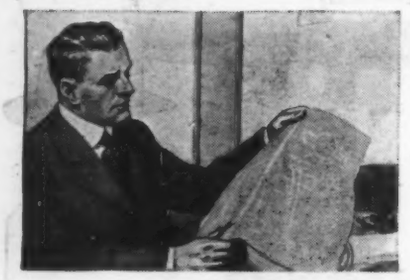

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Colors We Can't See

(*Continued from page 48*)

where only the cones are, that we focus objects when we look at them. The cones give us complete vision; the rods, only partial vision. With the cones we see all colors, but with the rods we see only black and white and their combinations, which are gray.

You can demonstrate this for yourself by fixing your gaze on a certain point and, without looking away from that point, gradually pass varicolored cards forward, from a position behind and at one side of the head, until they come within your field of view. The color of the cards will vary, under proper lighting conditions, as you bring them nearer and nearer to the center of vision. At first the color is vague and usually grayish, because then it is perceived only by the rods. Not until it comes within range of the cones, or near the center of vision, does it appear in its true aspect.

IF WE focus this central spot of the eye on any object, we see any color—red, green, yellow, or blue, or their combinations. But now, if we cut off part of our vision by covering the central area with a blind, we then see only blue and yellow, and white and black, with their combinations. That is what a bee sees. If we cover all but the outer part of the retina, we see only white, gray, and black—black being the absence of color. That is the color limit of a cat's vision.

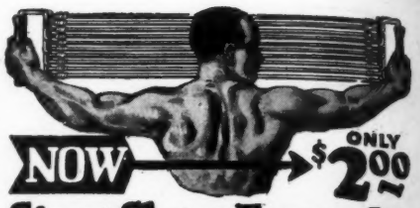
Now, according to Dr. Ladd-Franklin's theory, there have been, in the evolution of living things, these same three stages in the development of color vision. First, there was the black-white stage, found in the cat. When prehistoric animals first began to see, they saw not the many-hued world which we see, but one simply of whiteness and blackness. Secondly, there arose a blue-yellow stage, corresponding to the bee. And finally, there evolved the stage embracing all the colors yet experienced; the stage of man and of some of the lower animals, such as the dog and the bird.

A ray of light consists of a mixture of waves of different lengths, and the sensation of light and color which the eye gives us is due to the eye's reaction to these waves. In the first of the three stages, explains Dr. Ladd-Franklin, the eye had only one reaction to waves of every length—that giving the sensation of whiteness. That is, it saw only white and the absence of white which we call black.

WHEN the eye had developed to the second stage, it began to distinguish new hues. It singled out yellow and blue. To long rays it began to react so as to give the sensation of yellow; to short ones, blue. In the third stage the rays that had given yellow were in turn split up into long and short, the long giving the sensation of red, and the short that of green. The blue of the second stage, however, remains blue in the third stage. The eye has not yet learned how to split it up.

By means of the prism, or triangular glass, a ray of light can be divided into all the colors of the rainbow. All these colors are mixed together in the ray before it is thus divided, and they all come to us in light waves of different lengths. The shortest waves are those of violet rays. They are about fifteen one hundred millionths of an inch long. The longest are the red—about thirty one hundred millionths of an inch. Now, the eye can react to only a limited portion of these rays, those of medium wave length. When the lengths are very short, as in the ultra-violet, or when very long, as in those called the infra-red, our eyes fail us. Obviously, if we could develop a better eye there is no telling what surprises we might see.

To understand how the development from the first to the second and third stages might take place, we have only to try to look at yellow with one eye and at blue with the other eye at the same time. This (*Continued on page 151*)



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A definite program for getting ahead financially will be found on page four of this issue.

Colors We Can't See

(*Continued from page 150*)

can be done by holding a card on its edge between the eyes and along the nose, so as to keep one eye from seeing in the other's field.

Strange as it may seem, we don't see simply yellow and blue. We see a kind of white, or else we experience a rivalry between the two colors, as if one were trying to blot the other out. What happens is that the eyes attempt to see the two colors as one. If they succeed, in the case of the yellow and blue, the resulting sensation is white.

It seems quite plausible, then, that yellow and blue themselves might have originally come from white. And this is exactly what the new theory says. If, now, we try to see red and green at the same time, we see yellow instead, or else we get the same rivalry between the colors. And so, again, it seems plausible that red and green might have come from yellow in the evolution of color vision.

DR. LADD-FRANKLIN explains that the mixing of the colors in the above experiments occurs probably in the retina of the eye without our being aware of it, and is a chemical process. A ray of light, falling on the retina, is believed to decompose an unknown substance in the rods and cones, producing chemical action that gives us color sensations.

Studies of the spectrum, or artificial rainbow, indicate that with perfect eyes we ought to see at least 165 basic colors. Actually we see only the four—red, green, yellow, and blue. Why is this?

The answer, says Dr. Ladd-Franklin, is that the mechanism of the eye takes a short cut. Through the process of splitting up and remixing, it substitutes for the potential 165 different colors a bare four, together with certain blends of those four. If our eyes were capable of distinguishing more finely—as some radio sets can pick up more wave lengths than others—then we could begin to see more of the basic colors. A moment of figuring will reveal how much better eyes we need: If we now see only four primary colors, and if 165 exist, then we see only about one fortieth of what the world really provides! It is an amazing deficiency.

As we are, we can hardly distinguish between two color blends such as two blue-greens. Yet there are about forty different shades between those two. If the process of evolution in the eye goes on indefinitely it may be that eventually man will see on every side a display of colors such as would dazzle us beyond belief. He will then look back upon us as we now look upon the cat, and pity us for the drabness of the world of sight in which we lived.

Big Guns Traced by Air Puffs

HOW British scientists used the faint air pulses from German guns to locate and destroy them was told the other day by Sir William Bragg to the British Association for the Advancement of Science. It was a problem, he said, of finding some way to time the arrival of the pulse simultaneously at several points, so that surveying experts could locate the gun and give British artillerymen the range.

A British technical officer, listening to near-by firing within his battered hut, noticed that reports often were accompanied by a faint whistling, as of air rushing through the wall's chinks. He conceived the idea of making "electric thermometers," containing hot wires that would be chilled by the passing air wave. When they were chilled, the altered electric current would register on a delicate recording instrument. The method was tried, and proved successful; the firing of a big gun miles away chilled a wire perceptibly. Sir William revealed that the officer-inventor was his own son, Prof. W. L. Bragg, of Manchester.

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NO more awkward stabbing and hacking with old-style can openers! No more danger of blood poisoning from gashed and lacerated fingers! For now a remarkable new invention banishes every old-style can opene to the scrap heap. Now a simple twist of the wrist opens any can in a couple of seconds. No wonder they all simply go wild over it. No wonder salesmen often sell to every house in the block and make from $7 to $10 in an hour!

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You just slip the can in the holder and turn the handle. Nothing complicated, nothing to get out of order. Opens any can, square, round or oval, in a few seconds. And, men, IT'S TRIPLE PATENTED, so there is no competition.

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This queer little device doesn't just chop a ragged hole in the top of the can. It cuts the entire top completely out, clean as a whistle! The machine holds the can—opens it—flips the lid so you can grab it—and gives it back without any sharp edges to snag your fingers. You just put the can in the machine—turn the handle and almost instantly the job is done!

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Everyone knows how women detest the dangerous old-style can opener. Imagine, then, how they welcome this startling **new** method—this **automatic** way of doing their most distasteful kitchen task. Men, honestly I'm not exaggerating one bit when I tell you that not ten words are necessary to sell any of them! All you do is hand your demonstrator to your prospect and let her try it. She sells herself in ten seconds by the clock—and you pocket a nice, fat profit. Yes, really, it's just that simple and easy! That's why $75 to $150 a week is easy anywhere.

Act Quick for Free Trial Offer

I don't care whether you're an "old timer" or just breaking in. The quickest, easiest money of your life is waiting for you now, right here! That's a mighty strong statement. But all I ask is a chance to prove it at my risk. I know this proposition will coin money for you so fast that it will make your head swim! Territories are closing fast. The Free Test costs you nothing. Just mail me the coupon and I'll shoot you the most sensational dollar making plan you ever heard of. Mail it today! Right now!

Oh Boy!

How the Dollars Roll In

Makes $265 In a Week

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You simply can't realize how this great, new field is growing. Manufacturing companies, transport lines, airports, service and sales organizations are developing so fast that it's almost a physical impossibility to get intelligent, energetic, "air-minded" men to fill the important positions. In Aviation, the jobs are in line for the men—in other fields, the men are in line for the jobs.

Big Money on the Ground or in the Air

Don't think you have to fly to be a big success in Aviation. Good pilots draw substantial salaries—sure! But so do good mechanics, electricians, radio men, salesmen, instructors and many others. Aviation's best jobs aren't all up in the air—not by a long shot. For every plane that flies, there must be ten to forty highly paid, carefully trained specialists on the ground. Forget that Aviation was once considered a "game." Forget that just a short time ago it was still in its experimental stages. Instead realize that today it is the most efficient method of transportation the business world has ever known—and realize that within the next few years, it is going to make thousands wealthy and put countless others on "easy street" for life.

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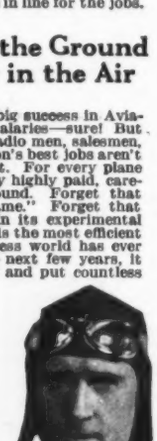
Under the guidance of one of Aviation's outstanding figures, Lieut. Walter Hinton, pilot of the famous Trans-Atlantic NC-4, and crack flying instructor for the Navy during the War—you can now get your "ground work" in Aviation *right at home.* In his remarkable, up-to-the-minute, fully illustrated course—which he backs with his own personal instruction—you get quickly, easily, inexpensively just the very training Aviation's big operators seek in the men they employ. Hinton's book, "Rich Rewards in Aviation" was written for YOU. Don't turn this page until you've told him where to send it.



Walter Hinton

One of the Navy's crack flying instructors during the war, pilot of the NC-4, first plane to fly the Atlantic, first Aviator to pilot a plane from North to South America, first pilot to fly to the wild regions of the Upper Amazon — that's Hinton, the man who is now ready to give you the cream of his many years and thousands of miles of experience. And he brings this foundation - building, money-making training right to your home. His FREE book tells you how.

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Cities Race for Airports

(*Continued from page 51*)

it cost to drain the land, to transform it into a level field? How much grading and stump pulling will be necessary? How close is it to main arteries of highway traffic? How close to the waterfront, and to the railroads? What about railroad sidings, light, power, water, gas, telephone, telegraph and wireless stations? All of these things may involve intricate figuring, and cannot be settled offhand. A field out in the country is not an airport, any more than a country railroad siding is a railroad center.

San Francisco is going after this problem in ingenious fashion, following a plan initiated by the acting postmaster Harry L. Todd. The scheme calls for an elevated airport, 1,200 feet long, 600 feet wide, and fifty or sixty feet above ground, forming a roof over the now exposed yards and passenger station of the Southern Pacific railway.

THIS mid-city airport, equipped with chutes so that mail can be dropped into trucks within a few seconds after it has been tossed from an airplane, will cut to fifteen minutes the present time of two hours between plane and post office. At present mail planes to and from San Francisco use the municipal airport at Oakland, Calif. It is expected that the saving in time on mail alone, by the new plan, will be worth hundreds of thousands of dollars to San Francisco business men.

New York has witnessed how business moves toward an airport, in the growth of suburbs near Roosevelt Field, Long Island. Garden City and adjacent communities are showing new life and increased property values because of the air traffic centering there. Naturally New York is too great a city to be jealous of such a slight shift in values, but nevertheless the biggest city in the world is planning an airport that will be the take-off of future trans-Atlantic flights. The site chosen is Barren Island, near the southwestern tip of Long Island, and the development envisions the aerial needs of the city forty years in the future. Clarence Chamberlin, trans-Atlantic flyer, has been employed to superintend the enterprise.

BACKERS of Roosevelt Field, meanwhile, are planning to spend $1,000,000 to develop it into an American Croydon. Machine shops, service stations, and an elaborate system of searchlights, beacons, and radio signaling will be developed. Its mile-long runway gives Roosevelt Field a big advantage over other eastern airports at present. But engineers believe that the airplanes of ten or fifteen years hence will require much less space for landing and departing. Witness the Navy's success in landing planes on the deck of a carrier.

The development of strange architectural shapes to accommodate the new needs of flying is foreseen by some experts. Dome-shaped airports with runways radiating in all directions are pictured. Underground hangars would account for that shape, the roof of the hangars serving as the flying field.

At Buffalo's well-equipped airport there are seven buildings, five hangars, an administration building, and a combined garage and power plant. The hangars are built of brick, glass, and steel. In the administration building, the manager's office, located in one corner, has a curved glass front that gives a view of the entire flying area. The building has been so designed that the wings may be extended later to house a post office, customs station, passenger waiting rooms, news stand, restaurant, and offices for commercial airline companies.

One thing is certain: the airport of the future will not have forty-eight kinds of signals and markers to confuse the aerial tourist, as motorists now are confused on land. A huge white circle already has been adopted as the sign of an airport. Other signs are to be controlled by Government regulations.

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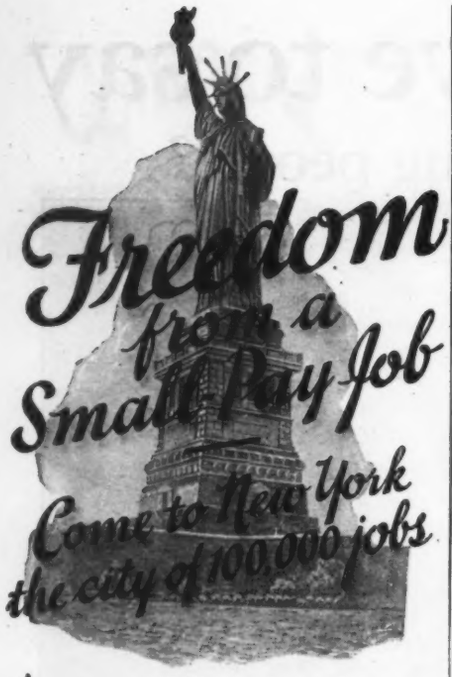

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The Used Car Bargain

(*Continued from page 76*)

accelerator pedals, too. Look at the steering wheel where your hands naturally grip it. It took a lot of pawing to wear away the wood like that. Then there's a terrible lot of play in the steering apparatus. They've tightened the adjustment till it works stiff without getting rid of the slack."

They were approaching a particularly rough and bumpy stretch of road. Gus took it at a fast clip. The car gave forth a whole collection of clattering noises as it bounced over the bumps.

"Sounds like every shackle bearing is loose and the joints in the brake rods as well," Gus commented.

"All cars are a bit noisy except when they're brand-new," exclaimed Estey. "I'll bet that boat you're trying to sell would sound just as bad."

"Not by a jugful!" Gus grunted. "You can try it yourself if you want to."

THEY headed for the Model Garage. The motor seemed to be getting more and more noisy.

"While I'm checking up on what's in the transmission and rear end," said Gus, "I want to see what kind of oil they put in the crank case. The usual stunt is to put in extra heavy oil to help deaden the loose bearings. That's a lot cheaper than taking down the motor and tightening them."

Gus got busy at once and sure enough, the transmission and the rear end both had been filled with a mealy mixture of heavy oil and fine sawdust. The crank case was filled with oil several grades heavier than recommended by the maker of the car.

"Now you drive this one," said Gus, beckoning to Estey to take the wheel of Hamilton's car. "Drive over the same route and at the same speed."

By the time they returned, Estey was thoroughly convinced.

"Gosh! What a lemon I did pick!" he sighed as he gazed disgustedly at the shiny varnish of the car he had been so proud of only a short time before. "I'm beginning to realize there's more to this secondhand car game than just the model number and the condition of the paint."

"I DON'T want to be a crape hanger," said the veteran auto mechanic, "but if you've taken that car on time payments you'd be mighty wise to charge the down payment to experience and let them have the car back again."

"Is it really as bad as that?" asked Estey doubtfully.

"Look here," Gus requested, stooping down and pointing to the frame of the car just under the edge of the mudguard. "Too much wear is bad enough, but this is even more serious. That isn't roughness in the paint on the frame right there. That's where the frame was broken and a welding job has been done. The car's been in a smash-up. No doubt of it. Personally, I'd never buy any secondhand car that had been in a smash unless I knew a whole lot more about it than I do about this one."

"That settles it," Estey roared angrily. "I'll make those crooks give me back my hundred bucks down payment or somebody's going to get all mussed up!"

"Do you think he'll get his money back?" asked Joe, after Estey had departed in his shiny pile of junk.

"Maybe they'll give him part of it to avoid a scrap. He's a pretty husky chap," Gus smiled. "But it's boobs like Estey who keep the 'gyp' secondhand auto dealer in business. It's a shame, too, because 'gyp' dealers give secondhand cars a bad name and make it hard for the honest automobile agencies to dispose of their trade-ins."

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It's Here—the All-Steel House

(Continued from page 34)

concrete floors poured, there existed the skeleton of a strictly fireproof building. Where insulation was required, of course, fireproof fabrics of felt were used. The steel roof trusses were covered with a sheet steel roofing, and over this insulating material and fireproof shingles.

In the basement was an electrically welded steel boiler, an oil burner drawing fuel from a storage tank of steel. In the kitchen were a variety of labor saving devices. Even the electric clocks were in steel cases.

One important feature of this dwelling was the trusses, made of expanded steel so that no members had to be cut to accommodate piping and wiring. As it stands that dwelling is a welcome risk to any company writing insurance against fires, tornadoes or earthquakes. Rats and other vermin can find within its walls no place to set up housekeeping. The people who live there are going to be warmer in winter and cooler in summer than the majority of their neighbors.

SUCH a house is out of the question for most Americans at present, just as automobiles were twenty years ago; but with realization that the small house of steel affords an opportunity in mass production like that which was seized by Henry Ford, steel men will seize the opportunity and reduce the cost through the magic of mass production.

In a bulletin issued in 1927 the American Institute of Steel Construction sets forth that on a $45,000 steel frame residence completed in Cleveland the cost of the steel members had been $300 less than would have been necessary for the purchase of an equivalent amount of wood; and that the labor saving due to the use of factory-cut steel had been $3,500. This was a saving, according to the reckoning of the Institute, of 8.45 percent.

When such a saving can be assured to the builder of a $5,000 home the small house of steel will be well beyond the experimental stage.

There is one other outstanding advantage in the steel house that will recommend it more than factors of strength, convenience or beauty to the family wishing to build an inexpensive home on a narrow margin of capital. It is the custom of finance companies to lend money on a first mortgage only when the roof has been placed on a new house. For that Detroit steel house it would have been possible for the owner to obtain the money to proceed with his building within a few days after the steel erectors completed their hundred-minute task.

WITH the ordinary house the owner sometimes has to wait months for the point where he can persuade a loan company that it is worthy of a first mortgage.

Because there is less hazard and less depreciation on the steel house the loan companies will be much more willing to advance money on them. If the average man of us can find one element that is more important than strength, safety, sanitation and beauty, that factor is ease of financing. In my opinion the steel house will have all these factors.

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Here Are Correct Answers to Questions on Page 69

1. The largest island is Australia. It has an area of 2,974,581 square miles. Greenland is second largest, 827,300 square miles.

2. The most important area is in western New York, especially near the town of Warsaw. Rock salt has been mined here for many years. If you could strip the surface soil from central New York, you would see that a large part of the state is underlaid by beds of crystal salt.

3. Many geographers believe that the driest place is the desert of central Arabia. It is reported there are places in that country where no rain has fallen for twenty years. Central Arabia has been very little explored by Europeans, and therefore this record has not been verified.

4. The emu, a bird of Australia. Next to the ostrich, the emu is the largest known bird. When the female emu has laid the eggs in the nest, the male bird occupies the nest and keeps the eggs warm until the little emus have hatched.

5. This is one of the Japanese names for the silkworm, a creature that well deserves the traditional politeness of the Japanese, for the silk it produces is among the chief commercial products exported from Japan.

6. At the Cape of Good Hope, and also in parts of Asia and northern Africa, the natives raise a remarkable kind of sheep possessing extraordinarily heavy and fat tails. One of these tails may weigh as much as seventy-five pounds. The meat of the tail is considered a great delicacy and the owners of the sheep frequently provide them with little wheeled sledges on which to drag their tails without injury.

7. The first landing of Columbus on the mainland was made, it is believed, in the neighborhood of Cape Honduras, north of the modern town of Trujillo on the north coast of the republic of Honduras in Central America.

8. Probably the desert part of Peru in South America. In the interior of this country and in parts of the country of Chile, which adjoins it on the south, there is one of the most completely rainless deserts in the world. Sunshine is almost continual during the daytime, even in winter.

9. The name "creole" was originally applied in the islands of the West Indies to persons born in the islands of European, usually Spanish, descent. Nowadays the word has largely lost this precise meaning and is applied to any of the French-speaking people in Caribbean countries or around the Gulf of Mexico.

10. This misfortune afflicts the small city of Cattaro, near Cetinje, in the mountains of the former monarchy of Montenegro, now a part of Jugo-Slavia. The mountains come so close to the little valley in which the city lies that an hour of sunlight is cut off by them every morning and every evening.

11. This is the name of a small, pink-and-black lizard that lives in the desert portions of southern Arizona, southwestern New Mexico, and northwestern Mexico. The beast is supposed to be extremely poisonous, but this does not seem to be true, although its bite sometimes produces a mild illness. Some Gila monsters grow to be eighteen inches long, although most of them are not more than eight inches.

12. Geologists believe that many thousands of years ago these trees were exposed for hundreds of years to water coming from hot springs. This water contained minerals in solution. Very slowly it turned the tree trunks to stone.

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Triumphs over Friction

(*Continued from page 59*)

which "oilless," self-lubricating bearings can be made. In the journals of railway cars, stuffing boxes packed with oil-soaked waste keep friction at bay.

Yet friction is not wholly a villain. You would miss it sorely, if by some miracle it were abolished. You could not step without fear of falling, for your shoes would act as if you had stepped on a banana peel. Pocket matches would cease to light when you struck them. You might achieve the dream of a perpetual motion machine—but you could not transmit its power by a belt, for the belt would slip.

IN YOUR car, friction is put to work to grip the road through antiskid tires and, at your command, stop the machine through fireproof asbestos brake bands. Iron grates on iron in the brakes of a speeding train. It would take twenty laborers seven days to accomplish as much work as the brake shoes do in a few seconds in stopping a thousand-ton express train speeding sixty miles an hour; and the heat generated at the brake shoes would cook twenty dinners for the men.

That accounts for what happens to the energy industry uses up in freeing its shafts from friction's clutches. It turns into heat. If you could keep the heat from escaping, you could boil water by stirring it. If you wished, you could even heat your house by friction! Years ago a machine was built, at Northampton, Mass., to do that very thing. Two horizontal, circular plates of cast iron, four feet in diameter and weighing 1,600 pounds, rotated upon each other within a brick oven. An account published in the New York *Sun* of January 7, 1834, said of them, "The ordinary speed, eight revolutions a minute, is sufficient to raise the temperature in the oven to 500 degrees within two hours. A funnel from the oven will convey the heat into any room."

The squeal of automobile brakes and the screech of trolley wheels rounding a curve tell where more of friction's energy goes. As noise, it echoes in waves through the air—and finally they, too, turn into heat! Only the other day, two experimenters, Dr. R. W. Wood, Johns Hopkins professor of physics, and Alfred L. Loomis, of Tuxedo Park, N. Y., succeeded in burning a hole through a chip of wood with sound waves concentrated in a thin glass rod.

WHAT causes friction? Really there are two kinds. The most familiar is that of rubbing surfaces upon each other. If you look at the apparently smooth surfaces through a microscope powerful enough, you will see that they are not smooth at all, but covered with innumerable points and hollows. As they move over each other, the projections of one, where they become caught in the hollows of the other, are continually bent aside or torn off. That takes force, and the force is friction. That is why rubbing surfaces in machinery are made of unlike substances, such as steel and bronze, whenever possible, so there will be less chance of the projections on one fitting into depressions of the other.

The second kind of friction is "internal;" it happens inside soft metal when you bend it, or inside water when you stir it. Strains set up between layers of which the substance is made oppose the motion and cause internal friction. That is why wire gets hot when you twist it.

Liquid friction is much less than that of solids. Therein lies the secret of why oil lubricates. A few drops between two rubbing metal surfaces form an "oil sandwich." Its outside layers are two thin oil films—one on each surface. They adhere so strongly to the metal that tons of pressure cannot squeeze them out. Between them is the "filling"—a free-moving, liquid layer of oil. When the metals rub, oil slides on oil instead of metal on metal, and you have substituted the minor evil of fluid friction for the grating, burning friction of solid metal.

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Young Jim

(*Continued from page 22*)

sweat-streaked scarecrow supplied. "Jim Dustin," thrusting out a dirty hand. His teeth were bared in a friendly grin—the only white spot on him—and he spoke quietly, as usual. "Pete told me where it was," he went on at once, "but my ears must be full of dirt; I couldn't understand him."

Slug Williams looked him up and down, threw a sidelong glance at Sam—and made a sort of a choice. He reached out and shook the hand limply. "Gonna stick around, are yuh?"

It was a choice, though most reluctantly made; such was plain to be seen. He did not get to his feet, neither did he smile except for a drawing down of the corners of his mouth, and the question he asked was packed full of a skepticism that was dangerously close to insulting. There it was—the antagonism of a lazy, narrow-minded man, and Sam knew a fear he had never felt before. The Old Man's son was up against something more than a hard job.

J. ORCUTT knew it, too. His grin disappeared for a moment, though he continued to regard Slug with steady eyes in which there danced that unquenchable fire. Then his teeth showed again.

"Yes," he replied. Slowly, almost thoughtfully. "I believe I will," after which he returned to the question at hand. "Where did you say the coke breeze was?"

And that was that. The joking was finished; a very serious business was to follow. Moreover, whatever it was that had caused the lad to start it, by the Gargantuan rolls that smashed down ten-ton ingots, it looked as though he were going to finish it! At any rate, he knew what he was up against, and Sam—he watched the grimy figure swing away down the floor in the direction Slug had indicated, and felt the beginnings of a relief which was to find expression in a new title for the boy. Not five minutes later, when he was concluding the errand that had been interrupted by a collision:

"WHAT'S this I hear about the Old Man's kid turnin' cinder-monkey?"

There are very few telephones in a steel mill. But news travels just the same, some of it like lightning, and such was the greeting Slim Jackson had for Sam when he climbed the stairs to the glass-fronted room built above the roll table some fifty feet back of the bloomer. Slim was sitting on a high stool with a man on either side of him, and all three of them were busy at the job of lengthening a snake of steel that crawled back and forth between the huge rolls in front of them. But all three pairs of eyes had flicked around when Sam entered; he had seen them in the light thrown up from the white-hot steel beneath. He suppressed a grin and replied:

"Yeah, he's workin'."

Shortly, pretending great preoccupation, Sam stepped in beside Slim and began to leaf through the pile of mill orders clipped to a rude desk in front of him. These men were curious, as every man on the mill would be within the next hour or so, and Sam—he continued to search for a certain sheet.

Silence, while the six hands manipulated six levers and the massive machinery responded. Silence, that is, in so far as speech was concerned. Otherwise the place resounded with the noises of production. The rumble of the great rolls, the silken swish of the water that bathed them, the clatter and bang as the heavy bloom was flopped over, the hiss and pop of the hot steel as the shining rolls took it between them, the steady pop of relay switches on a far side wall—they blended together in a din that only accustomed ears

(*Continued on page 159*)

Young Jim

(*Continued from page 158*)

could understand as those levers were pushed and pulled. And the three men—their eyes were front and their mouths were closed, but their ears were aching for news. Sam knew it.

"This heat—fourteen, twenty-one, ten—handle it with gloves," he ordered. "It's high manganese an' tricky; don't hog it down. Don't give it more'n a half inch at a pass. Twenty-two or so ought to do it."

Slim produced a pencil from his jumper pocket and made some marks on the sheet. He also took his cue. "Tell Slug to hot 'em up good," he said. But he could not resist adding: "What's his big idea?"

"What idea?" asked Sam, his eyes inspecting the long bloom as it crawled under their floor for the last time, headed back toward the shears and lighting its way as it went. As though he didn't know what Slim was driving at!

"J. Orcutt—working." In his impatience Slim almost snapped it.

"OH, YOU mean Young Jim. He's goin' to eat it up. That heat'll be along about noon; watch it," and he was gone.

"Young Jim"—later on Sam demanded the credit for thinking of that name and Slim Jackson confirmed it; just then it had slipped out. Maybe he did look like J. Orcutt when he drove from home to job and back again in his yellow roadster; maybe, after that first day, he did resemble the Old Man's son more than a regular employee when he fell in with the dun-colored line of men who made a parade through the timekeepers' gates three times a day; but when he changed to his working clothes and went to work with Pete, he was Young Jim.

For the Old Man's son was sticking—and putting up with the verbal attacks of a carefully warned Slug Williams. That news was all over the plant before the second day was done, from the main office on the hill all the way down through the column of great buildings to the timekeepers' gates. There was nothing to prevent the bearing of tales, and Slug Williams' two helpers became much sought after men. Not that they took part in what followed, for they were too busy. Some one or two of those soaking-pits was always being opened and closed, either for charging or discharging. One by one the stripped ingots had to be put to soak by a crane, and one by one they had to be taken out and sent off to the bloomer, and each time a roof had to be opened and closed again, which was their job. They could observe, however, and listen, because when one of those ceilings had to be rolled back all they had to do was open a valve; a hydraulic ram did the rest. So the mill heard, and as the days went by, wondered.

YES, J. Orcutt was whipping a job. He was slogging away in the dusty heat, poking cinder out, pouring coke breeze in; he was pushing a wheelbarrow in the long tunnel beneath; he was arousing Pete's enthusiasm—a difficult thing to do. It was hard. It blistered hands that weren't used to it; it turned a bright-eyed, whimsically talking visitor into a dull-eyed, silent clod at times. Yet he stuck in spite of it, and—took insults from Slug Williams.

Verbal ones, beginning on the evening of his very first day, when at quitting time J. Orcutt, black from head to foot, asked where the showers were.

"Showers?" cried Slug, then he laughed. "What for? This ain't Saturday."

"No, but I happen to be a trifle soiled," said J. Orcutt Dustin, 2nd.

"Do your washin' at home," Slug growled. "You won't be back tomorrow."

"That," said the other quietly, "is where I'm going to fool you." (*Continued on page 160*)

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Young Jim

(*Continued from page 159*)

"So, gonna be a regular hand, are you? Well, where's your time check?"

"That's right, I haven't any, have I? Well, I'll make the company a present of this day's work. Tomorrow I'll sign up," and he walked away from more slurs to find the showers himself, in a locker room built as a lean-to beside the wing where the monstrous reversing motor that drove the bloomer was housed.

It was a mistake, everyone said. He should have stepped on Slug then and there. Live and let live—that might be a good motto for the J. Orcutt who thereafter came and went as clean as a pin and dressed for anybody's parlor, but it was not the spirit that deserved the name Young Jim.

PETE REZNIK was the first one to express himself about it. He heard everything that was said—and Slug's remarks grew more and more acid each time he got away with one. Normally Pete was silent, his thin lips a tight crack across his gaunt face and his deep-sunk eyes inscrutable. But he liked Young Jim. He was turning out to be a good workman, and bright. Tell him once, and you didn't have to tell him again. So one day when they were down in the long, shadowy tunnel, where the heat of a hundred Turkish baths made the motionless air as heavy as lead, he let his feelings out.

"Sock him in the jaw."

The hoarse-voiced injunction took Young Jim by surprise. He lowered his shovel. "Sock who in the jaw?"

"Slug."

"What for?"

"Talkin' too much with his mouth."

"Oh, that?" Young Jim laughed and shrugged his shoulders. "He isn't doing any harm, is he? Why bother? He'll tire of it before long," with which he wiped the sweat from his forehead with a crooked forefinger and went back to work.

But Slug didn't tire of it. "Say, J. Orcutt Dustin, 2nd," he drawled one day, nastily as always, "did you ever figure you was takin' bread out o' some honest man's mouth?"

Young Jim had just finished a job and was tired, but he rolled his head around toward Slug and wanted to know how.

"By workin' on this job when you don't need the money."

"WHY, I hadn't noticed that anyone was asking for this job. Of course, if you should want it——" with that twinkle in his eye.

"He don't," croaked Pete. "He tried it once. For two hours."

"Who's talkin' to you?" Slug wanted to know, and Pete stood up, slowly.

"I am, you laughin' hyena, an' if you give me any back-talk I'll bend a poker over your head."

Young Jim reached out a hand and stopped him, or Pete might have set a greater record for volume of speech. "That's all right, Pete," he drawled across the nasty laugh of Slug, and that—for the moment—was that.

When the news leaked out, there was a general shrugging of shoulders, accompanied by downward drooping smiles. J. Orcutt might be quite a feller when it came to whippin' a job for the fun of it, but there's some things a man don't stand for—not if he's a man. Young Jim he might be—part way. Yet one thing was certain: when a feller stood by and watched a scrawny old cinder-monkey call a bigger man's bluff and declined to do the same—he was sure J. Orcutt the rest of the way.

Even Sam Thurber began to be ridden by a doubt. They were right, to a certain extent. There was a point beyond which no bully should be allowed to (*Continued on page 161*)

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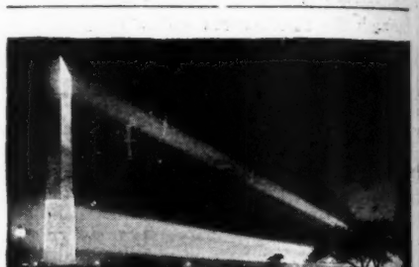

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A definite program for getting ahead financially will be found on page four of this issue.

Young Jim

(Continued from page 160)

go. Not that Young Jim was cowering, for he wasn't; he maintained his dignity through every dirty crack that was made. But—before long, unless he did something else, those skeptical smiles would be replaced by a most unpleasant word—yellow.

And what could Sam do? He had warned Slug more than once; he could go one step further and fulfill his threat by firing him on some trumped-up charge. But that would make it worse. Slug was a good heater, and of late he had been outdoing himself. If he should be given his time, J. Orcutt—Sam gasped as that old name slipped involuntarily into his thoughts—would be laughed out of the plant. The situation was rapidly growing intolerable.

To everyone but the one most vitally concerned. J. Orcutt Dustin, 2nd, remained as serene and indifferent as he had always been. Until, after two weeks had dragged themselves out, the shift moved on into the night turn and Slug in his rapidly mounting arrogance made his first mistake. He used his hands for the first time.

IT WAS close to midnight when he did it. He was tired, of course, but Young Jim was more so. His feet were dragging and his eyes were dull. Slug got up from his seat on the bench to make an entry on his blackboard. And Young Jim took advantage of it to sprawl full length upon the bench. Slug found him that way when he came back—and the lid flew off.

"Hey, what d'you think this is—a boo-dwor?" he bawled, and with one great hand he seized Young Jim by the shoulder and jerked him from the bench. "Get off o' there an' let a man sit down!"

Young Jim got off. He had to. The yank upon his shoulder sent him sprawling to the floor as though he were a half-filled sack of meal. But he came up, deliberately. Then he took the two steps necessary to bring him directly in front of Slug, who had seated himself, laughing.

"I don't permit that," he said slowly.

Slug's thick lips curled. "You don't permit what, papa's boy?"

"I don't permit men like you to touch me. Get up!"

"Haw-haw! Hear that? He orders me to get up! What for, darling?"

No answer from Young Jim. No verbal one, that is. His eyes were no longer dull; they blazed. He reached out a grimy hand, clamped his fingers upon Slug's nose, and pulled.

THEN it was that a fight took place that will never be forgotten as long as there is a soaking-pit at Midwest Steel. Slug was on his knees when the fingers released his nose, and leaped to his feet a raging maniac the next second.

But for one circumstance that battle would have been fought in a darkness almost complete. There were only three small globes, one at the blackboard, one in the tiny office, and one overhead; but there was plenty of another kind of light. One soaking-pit—Number Twelve, right next to where they fought—was about to receive one of the last ingots from the heat Slug had just chalked up. It was being opened when the battle started, and it stayed open, flooding the end of the building like a spotlight twelve feet square. Because the helper, seeing the two men go into action, dropped his hand from the valve and never gave it another thought. Furthermore, there was an ingot waiting to be lowered into the pit. It dangled in the great tongs that dropped down from a bridge crane—and dangled. The crane operator saw, too, and he had a grandstand seat.

What a fight! No rules there, no padded gloves, no bell. The (Continued on page 162)

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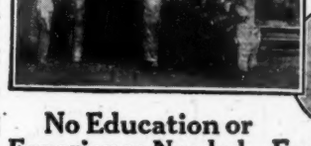

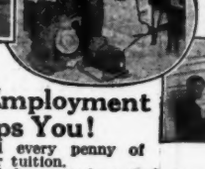

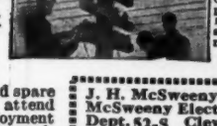

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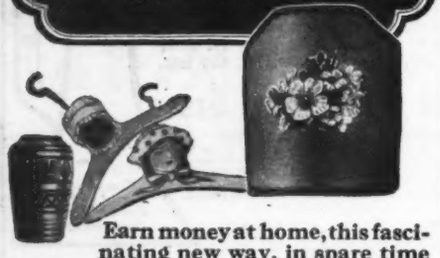

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Young Jim

(*Continued from page 161*)

ring was a narrow floor of steel plates, edged by a wall on one side and a long rail that shut off the rams and pistons of the soaking-pit ceilings on the other. The audience was three men—at first: Pete and his two helpers. After that——

Sam Thurber was in the building, talking to Slim Jackson. He could not hear Slug's roar, for the bloomer was at work; but he saw the flood of light that was not shut off and the ingot hanging on the crane's tongs. He arrived in no time, the bloomer crew behind him.

Slug landed the first blow, a haymaker that knocked Jim sideways. He staggered and would have fallen had it not been for the long rail. That he grabbed with his right hand, his stagger swinging him around until he struck it with his back. He had time to shake his head just once before Slug was upon him again.

THIS time he met the charge—with a straight-arm jab from his left that caught Slug fair in the mouth and set him on his heels. It was followed with a right that was too high; it struck Slug in the eye. Then Slug came in again, and his greater weight carried him through Jim's fists, his great arms closed around him.

There they were, locked and straining, when Sam Thurber panted up. He leaped onto Slug's broad back, cursing and demanding a halt, but he might have been a grain of dust. Neither of them heard him.

"Get me a bar; I'll crown him!" he bawled, but Pete Reznik grabbed his arm.

"Let 'em finish," he rasped, and Sam stood back.

It was plain that Slug was going to fight dirty, nor was anyone surprised. He was bent upon setting Jim's back against that rail. He was pushing, slowly, and Jim's feet were scuffling backward, while his hands waved uselessly below Slug's mighty arms. It looked to be defeat. Backward, backward, until the rail touched Jim in the small of his back, then Slug began to bow forward.

"Cut it out, you blackguard!" bawled Sam, and other voices joined him. Uselessly, for Jim had a trick of his own.

Suddenly he braced himself, lifted his feet from the floor and kicked. It knocked Slug's feet out from under him so that Jim's backward fling of his shoulders made them both describe a giant's swing about the bar. Slug struck the floor with a thud, and Jim lit on top of him, to jump up like a cat, prepared for the next move.

"Cut it out, Jim!" Sam yelled. "Get out o' there!"

IT WASN'T a good place to fight. It was narrower even than the runway, bounded on one side by the withdrawn ceiling of pit twelve and on the other by the long bar that reached from the ram to the closed door of pit thirteen. It was dangerous, too; especially when a brute of Slug's instincts was fighting. There was a chance—but Jim paid no heed. He stood over Slug and panted: "Come on; get up!"

If Slug had been up and Jim on the floor it would have been different; every one of the bystanders knew it. Some of them even yelled their advice.

"Jump on him, Jim! Stamp him down!"

But he didn't; he waited until Slug rolled over and got to his feet. Then it was a fair fight that no one will forget. Fair because he kept it so. He refused to let Slug come to grips again. And beautiful!

J. Orcutt Dustin, 2nd, he may have been; polo player and au[illegible]obilist, too; soft-voiced play-boy who ha[illegible]o guts; but he had also done something [illegible]se—an awful lot of boxing. For from that time on (*Continued on page 163*)

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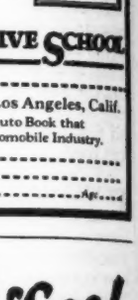

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Advice for POPULAR SCIENCE MONTHLY readers regarding safe and profitable investments. See Page 4.

Young Jim

(*Continued from page 162*)

he gave an exhibition that any welterweight might have been proud of. He slashed, and chopped, and cut—and Slug's face showed it; he danced, and ducked out of every charge—and Slug went crazy; he set himself for a finishing blow, and Slug crouched for a last charge.

"Look out! He's shovin' you into the pit!"

Who yelled it no one knew, but it expressed the horror of them all. Jim's defense had carried him backward step by step. He had landed punishing blows each time, but now he was in danger. Slug's rush—went by. Jim sidestepped—and Slug went on!

One step, two, then he tried to pull up. His feet skidded, he stared into the very face of hell—and screamed. Just as Jim's arm reached out and his hand grabbed Slug's overall suspenders. The skid was stopped—and Slug was a whimpering, cringing wreck.

"Take me away!" he cried through swollen lips. "Take me away!"

IN THE light from that inferno they could see his face. Both eyes were swollen shut and his face was a shambles. He clung to the one he would have crushed, and whimpered.

Back to the bench once more, but with what a difference! The erstwhile loud-voiced bully was now a frightened wreck. "Take me home," he mumbled. "Get me out o' here! Sam! Gimme my time; I'm done."

Water, clothes, and unguents from the ever-present first aid kit, with a slender, panting cinder-monkey standing by and watching. Until the whimpers had quieted and a bully's face was clean. Then——

"No, I don't think you want to quit, Slug," Young Jim said. "Not working, anyhow," and by all the ingots Sam Thurber's mill had reduced, there was a twinkle in his eye, a smile on an unmarked face! "All you want to do," he added quietly, "is to run your job—and help me do mine; how about it?"

A pair of ham-sized hands reached out; gropingly, for Slug was still almost blind. A pair of thick lips parted; stiffly, for they were badly swollen, too. And a husky voice answered:

"That you, Jim? Can I stick? Well——"

And that, thought Sam Thurber, was all there was to that. Except one thing more.. As they went home, three men in a yellow roadster, the quiet voice explained a thing or two.

"You see," it said, "my father began in the steel business as a cinder-monkey. I didn't know about it until a little while ago. Been too busy playing. So—well, I thought I'd try it out. Am I getting by?"

"Huh!" said Sam Thurber; and "Hell!" muttered Slug. Which seemed to be sufficient of a response to the question of Young Jim.

Radio Waves Cure Sick Mice

ULTRA-SHORT radio waves, of the type recently used in experiments at the General Electric Company's Schenectady, N. Y., laboratories and elsewhere, may have new value in the treatment of disease, Prof. Esau, of Jena, Germany, told the German Wireless Association a short time ago. In one experiment, he said, thirty mice infected with tuberculosis germs were exposed to powerful radio waves of less than three meters length, and half of them cured. A need for caution, however, in the treatment of human beings is seen in the heating of the blood, or "artificial fever," produced by the rays.

Dr. Esau declared that he had also succeeded in telephoning on these short waves, a feat not previously recorded, and had been able to transmit signals fifteen miles on power equal to that of a flashlight battery. He described a vest-pocket transmitter and a receiver no larger than a cigarette case.

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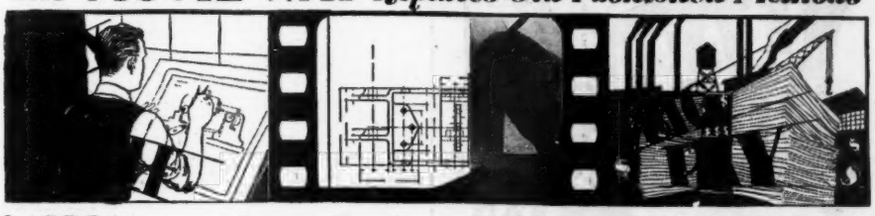

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Trapped 350 Feet Underground

(*Continued from page 31*)

of the miniature railroad. Frantically they uncovered him. The man was dead. Then they saw Nick Shrake. The miners knew that afterdamp had dropped him. They seized him and fled back to the comparative safety of the stairway, and got to the surface at last.

Such deeds of heroism are almost commonplace when disaster enters a mine. It is such self-forgetfulness and valor that has encouraged the Government to extend its mine rescue work by training the miners themselves in the use of life-saving appliances. About 40,000 are being trained each year. Since the Bureau of Mines was established in 1913, more than a quarter of a million men have received scientific instruction in underground life-saving.

WHAT caused that explosion in the modern, carefully protected mine at Mather? Two survivors offered a plausible explanation. They said they saw a flash of sparks when a cutting machine, used against the face of a drift, severed the insulation on an electric cable. Those bluish sparks ignited a cloud of fine coal particles hovering in the air, a highly explosive combination. As if following a powder train, that explosion swept along the corridor and into side galleries until it struck a tunnel where its leaping flame found rich food and exploded with a force that shook the entire mine.

Probably a similar cause was responsible for the explosion at Bluefields, West Virginia. Coal dust suspended in the air was not suspected as the agency of many mine explosions until comparatively recent times. Miners formerly attributed such explosions to some form of carbon gas. Occasionally a grain elevator blows up as if a ton of dynamite had been detonated within its walls. Experts know now that these explosions are due to the ignition of starch dust. Wherever the dust of combustible materials is present, industry is learning to guard against its hazards. In mines, nowadays, it is customary to fight dust with dust. Pulverized rock is blown onto the walls, roof, and floors of the corridors. This is a preventive against explosions.

MOST Government mine rescue workers are veteran miners, men grown wise to underground dangers. It was their ingenuity which developed the protecting walls—the brattices—which have enabled entombed men to survive for days after a mine explosion. That was the case with fourteen men who lived as prisoners for twenty-five days far back in a gallery of a French mine at Courrieres. An explosion, with its afterdamp, had killed 1,100 men of the 1,795 who worked in the maze of its galleries. Isolated groups fortified themselves against the approach of afterdamp by walling themselves up in remote galleries. They made brattices of mine timbers, coal dust, bits of cloth, their own garments, anything that would make a barrier against the deadly carbon monoxide. Some died from lack of nourishment after waiting days for relief that never came.

"The fact that fourteen men were found and rescued twenty-five days after the explosion," said C. P. White, an official of the Bureau of Mines, recently, "indicated that if communication could have been established not only these but probably many other miners might have been rescued within a few days after the explosion."

One of the problems with which White and his associates are concerned is the development of some unfailing system of communication whereby imprisoned men may exchange signals with men on the surface.

Two methods seem to promise usefulness. One is called the geophone, or earth vibration method. The signals exchanged are taps made with a sledge against (*Continued on page 165*)

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Trapped 350 Feet Underground

(*Continued from page 164*)

the rock surfaces. Delicate geophone receivers are employed to catch these signals. Efficient operation requires skill, and the signals would have to penetrate in some instances more than 400 feet of overlying strata.

The other method employs the roof rails of mine workings as electrical conductors. The transmitter is an ordinary microphone, the receiver a watchcase type of telephone. The big advantage of this system is that it permits the use of the voice.

All that Tom Trewartha had as a signaling appliance was a hammer and access to a section of water pipe that was suspended in a clogged shaft of the G. Papst mine at Ironwood, Michigan, during the disaster of 1926; but the rapping signals of his hammer on the pipe were enough to guide rescuers to where he was imprisoned with forty-two others.

HOW swift and effective is modern scientific rescue work was demonstrated last February, when fire broke out in an underground city of Canada. About 130 miles north of Lake Huron is the largest gold mine of North America, the celebrated Hollinger, with a hundred miles of underground passageways and electric railways cut into an incredibly rich deposit of gold-bearing ore. It was in this fabulous cave that fire began to ravage. Men poured out of the shafts at the surface as fast as cages could be lowered and raised, but a hasty check showed that fifty-one men were trapped in some of them perhaps miles from the exit shafts. In the tunnels 550 feet below ground the fumes seemed worst. From there dense clouds of smoke surged downward a third of a mile, drawn by the fan currents to the underground workers. The blaze spread below ground, mile after mile, the mine timbers roaring into flame under the draft.

Canada has no service to compare with the mine rescue organizations of our state and federal Governments. In this desperate situation officials of the Dominion appealed to Washington. Red tape was slashed. Rescue Car No. 3 was ordered to start from its temporary station on a remote siding in Pennsylvania for the burning gold mine in Ontario.

RECORDS were broken on that swift errand of mercy. Car and crew behind a powerful engine steamed out of Pittsburgh at 9:15 on the morning of February 11; at 6:30 the following morning it arrived at the Hollinger mine. Normally it would require at least forty-eight hours to make that journey

Those mine-fire fighters from the United States knew there was but one solution to the problem confronting them. The mine atmosphere had to be cleared quickly of the choking smoke. To do this the Americans entered the mine, with their Canadian hosts, all wearing oxygen breathing devices. As they advanced they erected canvas screens. Each screen marked the limit of a rescued area. By forcing air first through one such passage, and then through another, ways were cleared for the advance of other rescuers not equipped with breathing devices. By 11:30 of the morning of their arrival the rescue squads had reached the powder magazine and blocked it off. Two victims of the foul air there were taken to the surface and then further advances were made. By midnight, in places where previously it had been utterly impossible to see objects a foot away, the bodies of victims were being recovered. None, of course, had survived those unlivable conditions.

The Americans pursued their work all day Saturday, through Sunday, Monday, and part of Tuesday, without pausing for sleep, before their work was done. By Monday, so thoroughly had the mine passages been cleared of fumes that oxygen breathing apparatus was worn chiefly as a precautionary measure.

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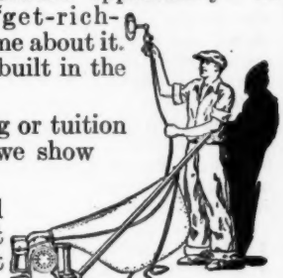

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Camera Reveals Surprising Facts About Great Men

(*Continued from page 24*)

Once, during the World War, when the King and Queen of the Belgians were visiting the front, an official photographer asked them to pose. His Majesty consented. Then the flustered photographer had to explain that his impromptu studio was in a cowshed! The Queen came to his rescue. "If the light is good there," she said, "nothing else matters." They waded ankle deep through dust and straw. King Albert seated himself. Then the Queen straightened out his hair, and put his trench helmet at just the proper angle. The photograph, against the war-torn background, was an excellent one.

Will Rogers, the cowboy humorist, regards all photographers as his friends until they prove themselves otherwise. Will wants them to give him a little time "for preparation," and then he is ready. His "preparation" usually consists of straightening his tie, which has a habit of twisting about in his collar, and of flattening down his hair. Invariably he looks down at the ground.

THE late J. Pierpont Morgan was a renowned enemy of all photographers. It was he who set the fashion of chasing them away with a club. He was sixty before he posed for a photograph. I discovered one reason why, the other day, in the private files of a New York photographer. It was an unretouched proof of a photograph of the great financier. It showed that Mr. Morgan had an unattractive bulbous nose, of which he was acutely conscious.

The present J. Pierpont Morgan inherits his father's hatred of the camera. He has, from time to time, employed husky detectives and guards to protect him from persistent photographers. This may be due to Mr. Morgan's known aversion to publicity, or to a fear of cranks, who might recognize him from published pictures.

John D. Rockefeller eluded the camera for years. On one of the first occasions when he consented to pose, a photographer asked him to remove his hat. He obliged—and the toupee he wore slipped down on one side of his head. The camera man saw it when he printed his plates, and knew it would make the oil king appear slightly ridiculous if it should be printed. He destroyed the plates! Nowadays John D. poses willingly enough, invariably wearing a cap or soft hat, but he wants to be shown "in action." When he is on the golf links he will hold a pose swinging a club or making a putt, but he rarely will stand still and face the lens.

JOHN D. ROCKEFELLER, JR., likewise shows no embarrassment in front of the camera, and usually smiles when he is asked to "Hold it, please!" His wife, however, does not share his nonchalance. One Easter Sunday Mr. Rockefeller, his wife, and little daughter were returning from church when photographers, seeking pictures of the socially elect on Easter parade, approached. Mrs. Rockefeller and his daughter posed. Some time later the multimillionaire oil man sought out the photographers and asked them, on behalf of his wife, not to print the photographs. She was afraid that kidnapers might memorize the child's face, and attempt to steal her!

Even though they have been photographed countless times, some of our famous men will show the public only a favored angle of their faces. President Wilson, for instance, seldom allowed himself to be photographed from the left profile. He had rather a large mole on his left forehead. On the other hand, the late Charles William Eliot, president of Harvard, would permit only his left profile to be shown. A birthmark covered a portion of the right side of his face.

(*Continued on page 167*)

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Camera Reveals Surprising Facts About Great Men

(*Continued from page 166*)

Henry Ford seldom sits for a photograph, and then it invariably shows his face full from the front. He objects to profiles, probably because his features are unusually sharp. When he and Mrs. Ford were crossing the Atlantic recently a portrait painter made a sketch of him. Mr. Ford paid for it, and then tore it up. Mrs. Ford explained that he "simply didn't like it."

There are many notable instances where photographs show a personality directly opposite to that of the subject.

General Pershing, in real life, is a pleasant spoken and affable man. But he will not approve any photographic portrait that does not show him stiffly erect—"every inch a soldier." He simply won't break into a smile voluntarily. Otto H. Kahn, the financier and patron of the arts, is an essentially modest and retiring man, usually good-natured and smiling. Yet when he sits for his portrait, he becomes straight-backed and stern.

PAUL WHITEMAN, the jazz orchestra leader, is a sober and thoughtful musician, with much serious work to his credit. But when he poses for his picture, he breaks into an expansive smile. A photographer may find him in the rehearsal hall where he is fuming at his musicians over the right shade of "blue" harmonics. But just before the shutter clicks he turns on the smile!

It is just the opposite with the jazz exponent, Vincent Lopez. He is an easy-going and smiling fellow in real life, but his photographs show him as grim as a mountain!

Prize fighters are not averse to being photographed, with the notable exception of Gene Tunney. He will stand for just so many, and then he gets nervous and irritable. He hates to be told to "give us a little smile." Most ring celebrities want to be photographed in their "fighting faces." Not so with Tunney. From his photographs one would think him as gentle and harmless as a Professor of Comparative Literature.

Jack Dempsey will pose all day, doing anything that the photographers may suggest, and keep smiling through it all.

Ball players are superstitious as Chinamen about having their pictures taken. A baseball star swears it is the height of bad luck to pose for a photograph before the first ball is pitched. If he loses, he is apt to go gunning to get himself a blankety-blank photographer!

BABE RUTH is perhaps the most superstitious of them all on that score. He hates to be photographed even after the game is won and the pennant is cinched. His photographs, in which the Babe invariably appears with a scowl, show it plainly enough.

When it comes to being photographed, actors are always actors. Unconsciously or not, they pose in what they feel is their best position. Nine out of ten break into a smile—and hold it. The notable exceptions are the Barrymores. They are serious actors, and they carry out their parts in their portraits.

The comedians, such as George M. Cohan and Al Jolson, present to the camera the face their public knows best—the twinkling eye and the broad-smiling mouth. They will think of the funniest story they know, and tell it silently to themselves while the photographer is changing his plates. Thus the happy expression that the camera catches, whether the subjects are feeling gay or not. Sophie Tucker, the comedienne and "Queen of Jazz," has to have a jazz band playing syncopated melodies while her face is being reproduced for the lobby displays. She prefers a jazz band in person, down to the last sliding trombone, concealed out of range of the camera. But if that can't be arranged then a

(*Continued on page 168*)

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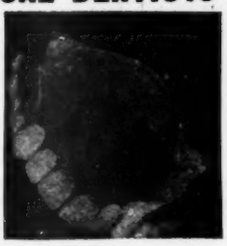

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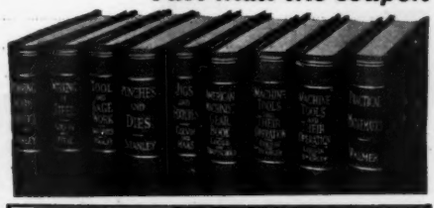

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Camera Reveals Surprising Facts About Great Men

(Continued from page 167)

radio will do. Or a phonograph, in the last extremity. But there must be a "hot" tune ringing in her ears while she watches the birdie.

Our presidents, on the whole, have shown comparatively few eccentricities before the camera. President Coolidge was strangely self-conscious of the camera during his early days in the White House. He is what photographers call a "difficult subject." His face must be lighted carefully, or lines and shadows will stand out too harshly. Mr. Coolidge early determined upon the facial expression he wished to show in his photographs, and he has consistently kept to it. His favorite pose is a three-quarter face, his eyes slightly below the line of the lens. He prefers not to look the camera straight in the eye, as was Theodore Roosevelt's habit.

THERE would seem, from all this, a moral to be drawn. If being photographed bothers you, strive not to become famous! But if you have to be photographed it will be well to remember a few simple rules established by the latest practical tests:

Don't "doll up." If dressed in uncomfortable new clothes, you will be conscious of them and your photograph will show it.

Don't be conscious of the photographer. To him you are an artistic subject, as a vase of flowers might be.

Be feeling your best, physically and mentally, before you enter the studio. Don't pose immediately after a heavy meal. The process of digestion draws the blood from your face, leaving it colorless and heavy.

If your nose is long, point it toward the camera, and it will seem shorter in the photograph. If you have a large mouth, don't force a smile, because that will make it appear even larger. In a full length photograph, or in a sitting position where your feet will show, point them toward the camera. If they are taken at an angle, they will appear unusually large. Pointed head-on at the lens, the camera foreshortens them.

Fat men and women should only have bust pictures taken, just the head and shoulders.

Most women like to be photographed. Here are some suggestions then, for the ladies:

Never be photographed in a hat. Hats go out of style too quickly, and what will make you look more ridiculous than a last year's hat?

DRESS simply; a gown of design calls too much attention to itself.

Very few women should have full length pictures taken. Feet and ankles don't take well.

Your hair should not be marcelled immediately before your picture is taken, because it will look stiff and unnatural. Have it waved the day before, if necessary, and brush it just before you face the camera. If you wear a hair net, take it off and loosen the hair with comb or brush. Otherwise it will look as if you are wearing a wig.

If your hands are to show, keep them sideways to the camera, and they will look slender and graceful.

Dresses of gray, cream, or lavender photograph better than those of blue, white, or red. The neck of the dress should be simple, with as little trimming as possible. Rings and jewelry should be worn sparingly.

Rouge used to photograph black on the lips, but nowadays the photographers use panchromatic lenses that are sensitive to every color but green. Use your lipstick if you wish, but get it on the lips evenly.

One of the best known photographers of women asks her subjects to moisten their lips and then whistle, just before she snaps the shutter. It relaxes the face muscles, and gives light and color to the lips.

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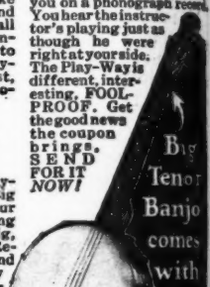

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Are You Fit to Fly?

(*Continued from page 15*)

18,000 feet without oxygen. The limit at which a flyer can retain consciousness without oxygen is about 25,000 feet, and before reaching this elevation a man's efficiency falls markedly. Altitude acts in a peculiar way. The effects creep on insidiously. The flyer may lose efficiency and even become unconscious without realizing that he is showing any sign of deterioration. It is possible to rate a flyer by a test on the ground, as to his ability to withstand the effects of high altitude.

SPEED in flying is another factor that calls for medical supervision of flyers. When we read of flyers attaining a speed of more than 300 miles per hour, we wonder where the end will be. The limit to flying in a straight line is a question, but when turns are made at high speed the flyer frequently has a moment of unconsciousness—when everything turns black. This is a matter of centrifugal action. As the plane turns at right angles to its former course it is banked, and the flyer's body is then at right angles to its former position. This results in draining the blood from the head, causing a temporary faint.

A French physician named Garsaux performed some experiments with dogs in which he rotated them rapidly on a wheel. Some of the dogs were killed by the rapid turns. Autopsy showed actual brain damage as the cause of death. Recently, a flyer in diving a ship at terrific speed and then suddenly zooming upwards, not only complained of faintness at the time, but for days afterwards was dull and his eyes showed congestion of the retina. This was probably a case of slight damage to the brain. There is a limit, then, to speed beyond which a man may not go and live.

IN CONCLUSION, then, do not plan on flying until you have been examined physically. After you enter the game keep yourself physically fit and look on the physical tests required as weather vanes of your continued fitness to fly. If you plan on altitude or speed flying consult a flight surgeon before you do it.

Odd Equipment of Byrd's Men

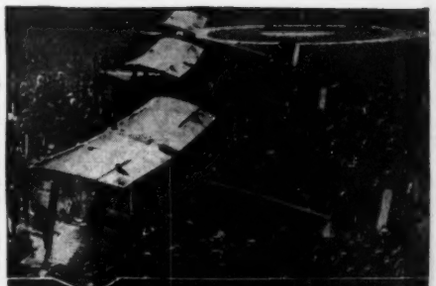
(*Continued from page 27*)

It would take a day, a night, and part of another day to exhibit the film.

Scientific instruments in bewildering array verify Commander Byrd's statement that this is to be an organized attempt to study Polar regions, rather than a spectacular dash of no lasting value. The $40,000 worth of technical equipment includes electrometers and magnetographs to record photographically all variations in the earth's electric and magnetic fields. Besides these instruments, a photomicroscope will picture minute living organisms in Antarctic waters, and a new sounding device will chart the little-known bottom of the Antarctic Ocean, trace the coast line of the Antarctic continent, and find if it could ever have been joined with South America as a passageway between the Old and New Worlds.

TEN thousand miles from the United States, and 2,300 miles from the last outpost of civilization in New Zealand, Commander Byrd will set up a fully equipped office where, aided by four clerks, he will keep a complete log of the trip and records of its discoveries. Seven typewriters, besides calculating machines, filing cabinets, and card index equipment, are in the ten-ton office outfit.

In magnitude of preparations, the expedition is without doubt the most stupendous undertaking in the history of exploration.



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A Prophet of Science Looks into the Future

(*Continued from page 17*)

Instantly the tubes became fiery blades in the darkness! His men stared, open-mouthed. They half believed him a magician.

In his Houston Street laboratory in New York, he exhibited a two-hundred-horsepower "Tesla Coil" carrying currents oscillating eighty million times a second. When Tesla placed a disk of lead on a stick and swung it over this coil, the lead exploded with a report like that of a cannon. Visitors to the laboratory, carrying keys and other conducting objects in their pockets, would cry out in pain as the metal became burning hot. But so confident was Tesla that the terrific electric force of this coil would not harm a human being, that one day he terrified spectators by placing his own head repeatedly inside it! He is alive, thanks to the correctness of his theory; but he tells me now that the mere recollection of his folly still sends a shiver down his spine.

Tesla's inventions cover many fields, including even an automobile speedometer based on a unique principle, in use today on high-priced cars, and a new pocket-size revolution counter soon to be seen. He even delved into the super-speed "sound" vibrations, recently produced in the laboratory of Alfred L. Loomis, at Tuxedo Park, N. Y., which kill small animals. He once built an apparatus, intended to sterilize water, which produced vibrations powerful enough to paralyze the hand, plunged in a tank of liquid.

AT THE time I talked to Dr. Tesla the newspapers were discussing the possibility of the flight of a rocket to the moon.

"No rocket," he insisted, "will reach the moon save by a miraculous discovery of an explosive far more energetic than any known. And even if the requisite fuel were produced, it would still have to be shown that the rocket machine would operate at four hundred and fifty-nine degrees below zero—the temperature of interplanetary space.

"The mean distance of the moon," he explained, "is 238,862 miles, and its mass 1/81.8 that of the earth's. Travel 215,085 miles away from the earth, and the gravitational attraction of earth and moon will be equal.

"To project a missile as far as that point will mean starting at an initial velocity of 6.8815 miles a second—not making additional allowance for the atmosphere's retarding action. And irrespective of this speed, which might be less in a rocket than a projectile from a gun, the actual work performed in lifting each pound of weight skyward would be 20,499,712 footpounds of energy, requiring 26,346 B. t. u., or heat units, produced by the burning of the fuel. Even if the rocket weighed only a pound for every pound of fuel it carried, just twice this amount, or 52,692 B. t. u., must be developed for every pound of fuel.

"NOW when you consider that the thermal efficiency could hardly exceed forty percent, and the mean propulsive efficiency fifty percent, 263,460 B. t. u. must be evolved by every pound of fuel—an enormous quantity of energy, about sixty times greater than that of dynamite! Although diminishing fuel weight and weakening gravity would make the rocket's path easier as it progressed, it is evident that no known fuel could drive it clear to the moon."

This discussion of tremendous power suggested the possibility of harnessing atomic energy.

"The scheme is worse than that of a perpetual motion machine—for the latter will almost work!" he exclaimed. "A motor driven by atomic power is unrational because it would take far more energy to break up an atom's structure

(*Continued on page 171*)

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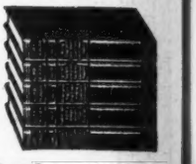

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Advice for POPULAR SCIENCE readers regarding safe and profitable investments. See Page 4.

A Prophet of Science Looks into the Future

(*Continued from page 170*)

than can be recovered in more useful work."

On the whole subject of matter, in fact, Dr. Tesla holds views that are startlingly original. He disagrees with the accepted atomic theory of matter, and does not believe in the existence of an "electron" as pictured by science—or, he maintains, if it can exist at all, it does so only in perfect vacuum.

"To account for its apparently small mass, science conceives the electron as a hollow sphere, a sort of bubble," Tesla says. "Now, a bubble can exist in such a medium as a gas or liquid because its internal pressure is not altered by deformation. But if, as supposed, the internal pressure of an electron is due to the repulsion of electric masses, the slightest conceivable deformation must result in the destruction of the bubble!

"Just to mention another improbability, the force tending to tear an electron apart is, in pounds per square inch, represented by the staggering figure of 256,899 followed by twenty-one zeros—and this is 513,798,000,000,000,000,000 times greater than the tension that tungsten wire can withstand! And yet it does not burst! Not even when it is hurled against an obstacle with a speed hundreds of thousands times greater than that of a bullet!

AND—more widely interesting in this day of radio—this strange, many-sided man clings to the opinion he expressed in his scientific investigations published from 1896–1898, that the source of all rays we know is always a stream of tangible particles or "corpuscles," rather than waves or vibrations. Even before the discovery of radium, Tesla expressed his belief that radioactive rays were of this sort, a view ridiculed at that time. When radium was discovered it was found actually to emit particles of matter—flying nuclei of helium atoms, called "alpha" rays. Tesla has maintained ever since that radium is not a generator but a transformer of energy, the emanations being caused by cosmic rays of immense power capable of penetrating all obstacles however thick. The existence of this radiation—which, he says, should not be confounded with the comparatively very feeble "cosmic rays" observed more recently—he has proved by mathematical theory agreeing closely with experiment.

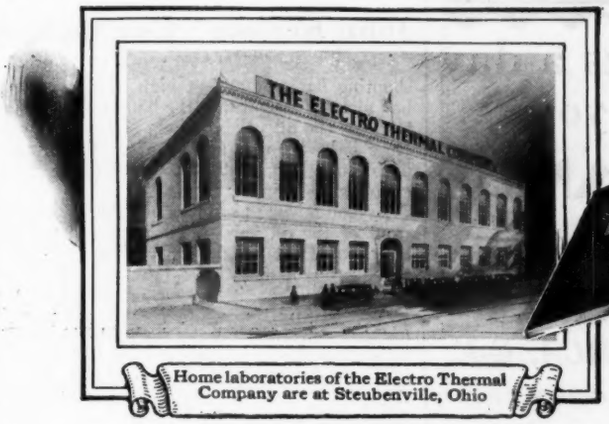
These conclusions Tesla has drawn from experiments with a remarkable vacuum tube of his own invention, with a single electrode, operated at millions of volts.

I asked Tesla what part of his life work lay closest to his heart. And the answer surprised me. It was not the world wireless system, nor the airplane. It was not the induction motor, today the basis of industries in which billions of dollars are invested all over the world. Instead, it was the discovery of the principle that preceded the induction motor—the "rotating magnetic field."

"When I made the discovery of the rotating magnetic field," Dr. Tesla said, "I was a very young man. The revelation came after years of concentrated thought and it was my first great thrill.

"It was not only a valuable discovery, capable of extensive practical applications. It was a revelation of new forces and new phenomena unknown to science before.

"No," Dr. Tesla said with some feeling, "I would not give my rotating field discovery for a thousand inventions, however valuable, designed merely as mechanical contraptions to deceive the eye and the ear. A thousand years hence, the telephone and the motion picture camera may be obsolete, but the principle of the rotating magnetic field will remain a vital, living thing for all time to come."



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John Kenlon—Fire Fighter

(*Continued from page 38*)

shooting flames 100 feet high, the hay sheds had already caught fire, the flames were rolling towards the oil yards, barely sixty feet away. Here indeed was a situation calling for allopathic or "knockout" treatment of the most concentrated kind.

Kenlon massed his forces in a sharp wedge in front of the oil yards. He then ordered the largest available nozzle—a four-inch monster—to be brought directly to bear upon the base of the flame as it attempted to cross the street. By putting a pressure of 145 pounds on that four-inch nozzle, he knew he would be getting the maximum delivery of water—more than 3,000 gallons per minute from a single hose. This murderous torrent killed the flame with a solar plexus blow, and permitted the firemen with smaller streams to beat back the thoroughly disheartened blaze.

EXACTLY the opposite tactics were employed at the Equitable fire a year later. Here also the flames had to be kept from leaping across a narrow street. But instead of being a single head of flame, the fire front was 575 feet long, and had to be held in check with a wide, continuous water screen. One, two, or even three powerful streams would have been of no avail. Kenlon therefore poured fifty or more small streams along this extended front, and effectively kept the fire hemmed in upon itself.

Scientific exactness has entered Kenlon's fire calculations in many other ways. His knowledge of architectural mathematics, for instance, enables him to gage with unerring skill the limitations of building material. He knows how much fire a steel girder will stand; how long a wall of any given composition will endure heat, and which way it will fall. His fellow officers say that no fireman who obeys Kenlon's instructions will ever be pinned beneath a falling wall. At the Equitable fire he climbed to the twenty-fifth story of a near-by building to view the progress of the battle. Immediately he sent orders that the Pine Street fire lines be closed entirely, and that no one—not even firemen—be allowed inside the lines. His precautions were justified a few minutes later when a sudden outward collapse of the walls filled the streets with an avalanche of smoking débris.

INTUITION? Perhaps. But John Kenlon believes that a scientific knowledge of cause and effect has checked more fires than any mythical sixth sense. To ground New York firemen in the basic theories of fire mastery, Kenlon evolved a plan for a Fire College, at which every member of the department should receive instruction in hydraulics, engineering, construction, and allied building sciences. He was the first president of the Fire College, established in 1913, and still gives daily lectures on a wide variety of subjects to his firemen students.

Waterfront fires always have been a special menace to seaport cities, and New York with its 600 miles of waterfront (a coastline longer than many seaboard states) presents a fire hazard without parallel in any other city of the world. The chief of the Marine Division, in charge of New York's fleet of fire boats, must be a well-balanced combination of harbor pilot, coastwise skipper, and first-rate fire general. Kenlon's fourteen years as a salt-water sailor fitted him admirably for the chieftancy of the Marine Division, to which he was appointed in 1909. In that year he checked, by his own skill and courage, a conflagration at Pier 15 that might easily have reduced the North River waterfront to a region of charred docks and warehouses.

"That fire," said Kenlon, "was the wickedest blaze I ever got mixed up in. Ships, piers, and warehouses all going at once—Washington Market blazing

(*Continued on page 173*)

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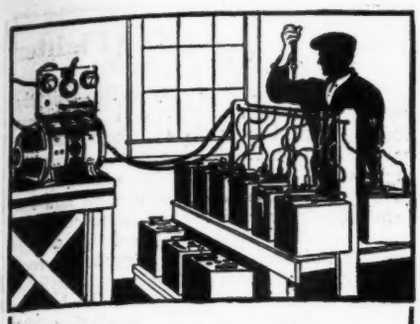
A definite program for getting ahead financially will be found on page four of this issue.



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POPULAR SCIENCE MONTHLY
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John Kenlon—Fire Fighter

(Continued from page 172)

inland, and a burning forest of masts surrounding us on three sides. The only thing that wasn't burning was the water in the harbor—and that was so hot you could have boiled turnips in it."

The fire started in some rubbish on Pier 15, which stretched for 850 feet out into the North River. Tar, essential oils, and leather—all combustibles of the "smoky" variety, were closely packed on the pier, awaiting shipment. The space between Piers 15 and 16 was jammed with small craft, and twenty minutes after the fire started, the whole waterfront for 500 yards was ascending in a cloud of glory. Piers, warehouses, and small craft were wrapped in blankets of searing flame and greasy smoke. Two large coastwise steamers, the *Yale* and the *Herman Winters*, caught fire at anchorage. The heat was so intense that some buildings in Washington Market 300 feet away were set afire *by radiation*. It was in this alarming crisis that Chief Kenlon, recently appointed commander of the Marine Division, arrived from Battery Headquarters in his launch.

BOARDING the fire boat *James Duane* he ordered the pilot to steer directly into the mouth of the flame, yawning between Piers 15 and 16.

There was a double reason for this maneuver: first, Kenlon wanted to strike at the base of the warehouse fire and choke it at the source; second, he learned that three men had been forced to jump from Pier 15 into the water, and were now floating with only their noses above the surface, in the middle of a boiling puddle.

But no fire boat, it seemed, could push its prow into that inferno without being consumed like a straw. It was like sending a company of infantry to certain extinction against a hundred batteries of heavy artillery. Kenlon, however, ordered the fire boat *Willett* to concentrate its fourteen lines and deck pipes upon the *James Duane*, thus protecting it by a Niagara water screen. Under cover of this water barrage, Kenlon gave the signal to proceed to the rescue of the three men. But the pilot, either terrified or overcome by the intense heat, lost control of the wheel. The *James Duane* started to drift aimlessly among the burning craft, until Kenlon himself leaped to the wheel. Guiding the fire boat into the furthest corner of the flames, he disappeared from view while the *Willett* shot random streams after the vanished leader. Meanwhile Kenlon was dousing the warehouse at the base of Pier 15 with a harborful of water—20,000 gallons a minute—standing at the wheel while the fire scorched every stitch of clothing off the upper part of his body.

AN HOUR later he emerged from the shambles, bearing the three men he had rescued with life lines. Pier 15 no longer threatened the waterfront, but Kenlon's face, chest, and arms were cruelly blistered. His clothes had been literally burned off his back—but he had succeeded in carrying out his plan of attack. Which, to John Kenlon's stubborn danger-loving way of looking at things, was more important than a singed moustache or a ruined uniform.

"Smoky fires" are dreaded by all firemen, but within recent years the number of such fires has been on the increase. Factories that use chemicals, rubber, oils, and leather make the "dirtiest" fires, since smoke from such fires is denser and greasier than smoke from lighter, drier goods. Kenlon describes the Grand Street fire of May, 1924, as the "most punishing" he ever fought, chiefly because it generated such heavy smoke that fifty firemen were overcome, and the chief himself nearly collapsed after the battle.

The fire began *(Continued on page 174)*

The Gambler

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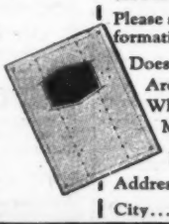

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John Kenlon—Fire Fighter

(*Continued from page 173*)

in the cellar of a five-story building at the corner of Grand Street and Broadway. Stocks of rubber goods and heavy textiles gave off impenetrable clouds of smoke; the night was hot and damp, the smoke refused to rise, and dozens of firemen were laid low before Kenlon arrived. He penetrated to the center of the building and found that a large circular stairway ran directly up to the roof, where it was surmounted by a glass skylight. Kenlon ordered this skylight to be broken, with the result that a rapid ventilating draft was created to carry off the smoke. He then stationed his men on the roof and had them pour ten thousand gallons of water a minute into the heart of the flame. It is significant that while fifty firemen were knocked out by smoke before Kenlon arrived, not one was overcome after he took charge!

This and a thousand similar incidents have persuaded most firemen that John Kenlon brings a rare and flexible quality of genius to his task of mastering fires. Believing as he does that every fire problem has an accurate solution, he has made it his business to discover that solution in the quickest possible time, and with the least danger to his men.

The question is often asked, "Why has New York had no great conflagration?" With dangerous fire hazards on all sides, with a teeming population, and with high prevailing winds, it seems almost miraculous that the city has not been scourged by a great conflagration. Ask John Kenlon for an answer to the question and he will say quite humbly:

"We have all been very lucky here in New York."

But who can say what portion of that "luck" has been Kenlon's effort to establish fire-fighting on a scientific basis, and his personal success in keeping it there?

Next month: How John Kenlon's application of scientific principles to his job has revolutionized the whole profession of fire engineering.

New Events in Astronomy

(*Continued from page 58*)

shaped border of the sun visible. Unfortunately, the eclipse lasts too short a time for valuable observation; in the most favored place it will remain total but a second and a half.

If a Comet Should Hit Us

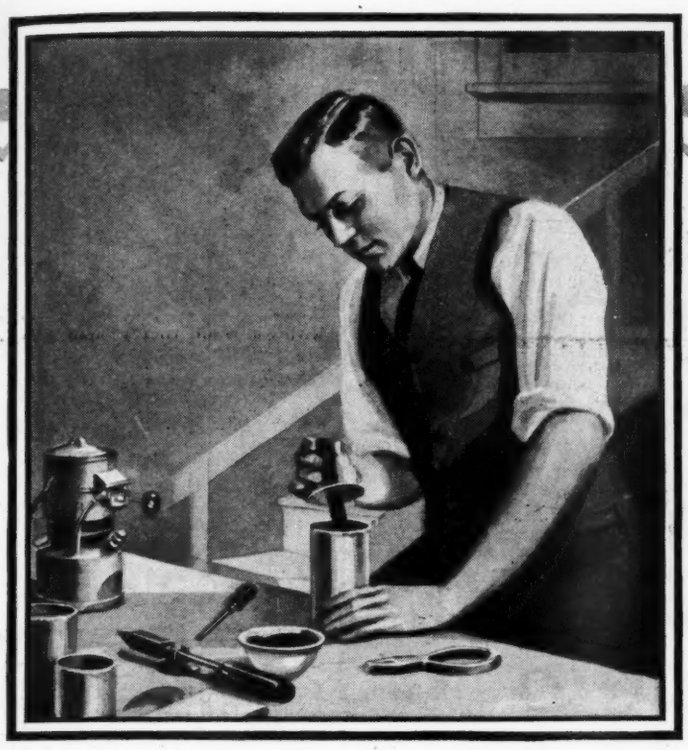
WOULD a head-on collision of the earth with a comet—a perfectly possible, though unlikely, occurrence—spell the world's doom?

"It might be disastrous—or it might be more spectacular than dangerous," says P. Davidovitch, of Harvard Observatory. As far as we know, comets are simply loosely-knit swarms of flying meteorites, whose direct impact might not even jar the earth. Probably a comet merely grazing us would be torn apart by the drag of the earth's gravity and fall as a shower of meteorites. This is thought to have been observed on more than one occasion.

Nor would there likely be danger if the tail of a comet—known to contain such poisonous gases as carbon monoxide and the more deadly cyanogen—should sidewipe our world, so thin are its gases. In 1861 the earth actually passed through the tail of a great comet, but the few who knew it saw only a slight dimming of the sun and a curious yellowish-tinted sky.

Not since 1910, which saw two great comets, has a really brilliant one crossed the sky.

Where do they come from? Today it is believed that they are stray wanderers within our own solar system, members of it as much as the planets and moons. Fortunately they are not weighty enough to interfere with the motion of the planets; the largest of them all, a giant of 1843 with a tail 150,000,000 miles long, passed close to us without producing the slightest effect upon the earth's orbit.



Lots of people know how to make a dry cell—but *not* the Eveready Columbia

PROBABLY you know how to make a dry cell. No secret about it. The principal ingredients are zinc, sal ammoniac, manganese, carbon. With just those four things you could make a dry cell that would work—for a time. But we add tiny quantities of other things, too, measure them with great exactness, add them just so, control every process by laboratory tests, and turn out a product that is scientifically exact. Some of the ingredients we mine in our own mines, refine in our own mills, and thus govern quality completely. There's no secret about the Eveready Columbia except this: We know how to make it. Thirty-three years of scientific investigation and controlled manufacture have developed it until today it is the greatest dry cell made. Available in single cells, and in batteries of 4, 5 and 6 cells, 6, 7½ and 9 volts, ready-connected in a waterproof steel case and sold as the Eveready Columbia Hot Shot.

EVEREADY COLUMBIA Dry Batteries
-they last longer

NATIONAL CARBON COMPANY, INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

FOR RADIO: *Insist on the No. 7111 dry cell, six inches of battery goodness, scientifically designed to give its best results on radio sets using tubes of the WD-11 and WX-11, and UV-199 and UX-199 types.*

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Be There with BT

Bremer-Tully Radio

Ⓘ

"The Finest We Ever Heard"

—the verdict of those who appreciate the best

THE Bremer-Tully record for *highest quality* is well-known to every radio enthusiast—and *even that has been exceeded* in these latest B-T models.

Backed by seven years intensive manufacturing experience they offer you your safest radio investment.

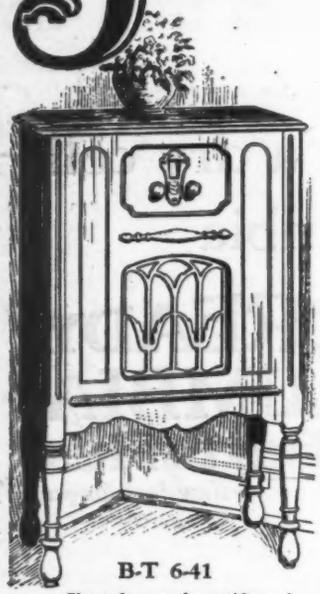
Every B-T product is *Quality* throughout. Not a single item was ever built to sell on price—yet you will find that Bremer-Tully Quality costs less in the end—and brings you much greater satisfaction meanwhile.

Furthermore, you will find that Bremer-Tully radio is handled by the best merchants—Those who sell quality only.

Send coupon for details

Bremer-Tully Mfg. Company

656-662 Washington Blvd. Chicago



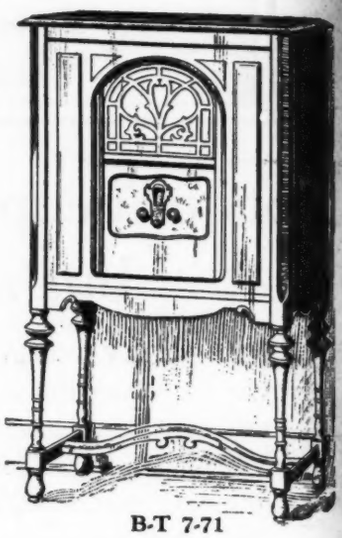
B-T 6-41

Six tubes and rectifier, A. C. only, single control, dynamic drive. An exclusive feature—the Antenna Compensator provides far greater sensitivity than would be possible otherwise. American walnut cabinet. Price, less tubes $190.00.

At top of page

B-T 8-21

Chassis same as B-T 8-21. Beautiful burl walnut cabinet, dynamic speaker. Price, less tubes, $375.00.



B-T 7-71

Seven tubes and rectifier, A. C. only, single control, push-pull power audio, dynamic drive. A brand new B-T feature provides for choosing tone characteristics as preferred and insures pleasing reception at many times when static ruins ordinary set performance.

American walnut cabinet with decorative maple overlays, sliding doors. Price, with built-in Dynamic Speaker, less tubes, $280.00.

Are you interested in Television? We are at work. Send the coupon and we will advise you as soon as there is anything definite.

COUPON

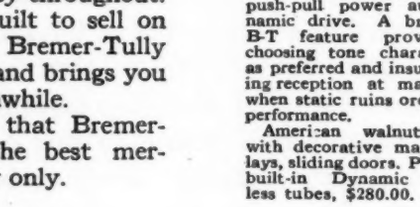
Send details on
☐ Radio Receivers
☐ Cone Speakers
☐ Dynamic Speakers
☐ Demonstration
☐ Television

Name ..... ☐ Dealer

Street .....

City .....

PS-11



B-T 8-20

Eight tubes and rectifier, A. C. only, single control, B.-T. rejector and other exclusive features, Walnut cabinet. Price, less tubes, $230.00.

Ⓘ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

R. R. DONNELLEY & SONS CO., CHICAGO

Hands *that haunt and threaten*

A HAUNTING NIGHTMARE of hands, shadowy and menacing .... What about them could possibly make this roaring lion of a politician cringe before the very hands which he has shaken so glibly all day?

Germs!

Politician or poet, salesman or sob-sister, musician or mother; all must face this fear. Every time the clasp of greeting or friendship is extended, millions of germs may "change hands."

They may be the germs which cause you to catch cold, sore throat, or even worse. The germs that enter your nose and throat passages from your hands which have touched those of a person with a cold, or which have merely touched something that he has handled.

Protection and peace of mind is assured with Listerine, the safe antiseptic.

Mild and soothing even to tender tissues, full-strength Listerine has deadly power against germs. Repeated tests, separately conducted in three noted Bacteriological Laboratories, have agreed in proving that Listerine kills Micrococcus Aureus (the pus germ) and Bacillus Typhosus (the typhoid germ), in less than 15 seconds! In all tests, the average number of bacteria was more than 200,000,000 per cubic centimeter (a cube less than four-tenths of one inch on each side).

This germicidal power of Listerine, demonstrated on the standard bacteria used by the U. S. Government in testing antiseptics, explains its 47-year proved effectiveness as a gargle for sore throat, and as a safeguard against infection.

This winter learn how Listerine can help you. Gargle with this pleasant antiseptic morning and night, and repeatedly after exposure to bad weather or large groups of people. And before every meal, before touching the face at any time, rinse the hands in full-strength Listerine.

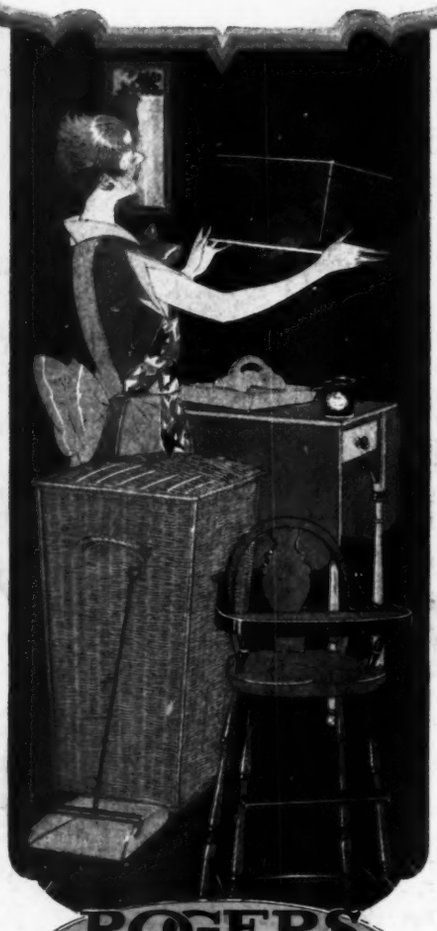
We believe that you will be pleasantly surprised by a winter in which colds trouble you much less than previously. Lambert Pharmacal Co., St. Louis, Mo., U.S.A.

FOR SORE THROAT

TO AVOID COLDS

Listerine kills germs

You take no risk if you use "ROGERS"



DRIES WHILE YOU WAIT
Our "Money-Back" Guaranty
Try one can of Rogers Brushing Lacquer. If not more than satisfied return what is left to your dealer. He is authorized to refund the entire purchase price.

THE amazing qualities of "Rogers"—its pure rich colors—its quick-drying feature—are characteristic of this modern home lacquer.

Its nature is to flow evenly—to level out beautifully and dry hard in a few minutes. Just as it is the nature of "true" varnishes and enamels to dry very slowly.

That is why genuine "Rogers" is so easy to use—why it gives such exquisite results in the hands of amateurs—why it is so remarkably durable on any surface . . . why many millions of cans have been used in our American homes.

You merely flow "Rogers" on with a full brush. Small articles may be dipped right into it. No expert brushing is needed. "Rogers" quickly levels itself. Then it DRIES WHILE YOU WAIT. Dries smooth—no laps or brush marks. Dries free of dust. Dries to a tough, hard, porcelain-like finish that wears and *wears* and WEARS.

ROGERS
THE MARK OF QUALITY

BRUSHING LACQUER

Accept no inferior finish in which beauty of colors and durability have been *deliberately sacrificed* to hasten drying.

Remember, only a *"true"* LACQUER, like *"Rogers,"* can dry quickly and retain its beauty and long wearing qualities.

Many charming colors

Genuine Rogers Brushing Lacquer is offered in 26 beautiful, rich, "modern" colors. Also black, white, clear and four fascinating Vogue finishes, Sun Glow, Platinum Tone, Fire Glow and Fairy Green. And every can is sold on our publicly advertised, *"Money-Back"* guaranty.

Leading paint, hardware and department stores, everywhere sell "Rogers." To avoid *imitations*, insist upon the name "Rogers" and the famous "Oriental" can shown here. None other is genuine.

DETROIT WHITE LEAD WORKS
Detroit, Mich.
Makers of Highest Grade Paints, Varnishes, Colors, Lacquers

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